CIVIL ENGINEERING

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A Large Hammerhead Crane at Puget Sound Navy Yard
Four 14-In. Guns, Four 6-In. Guns, and Two Pieces of Armor Plate Make Up the Test Load

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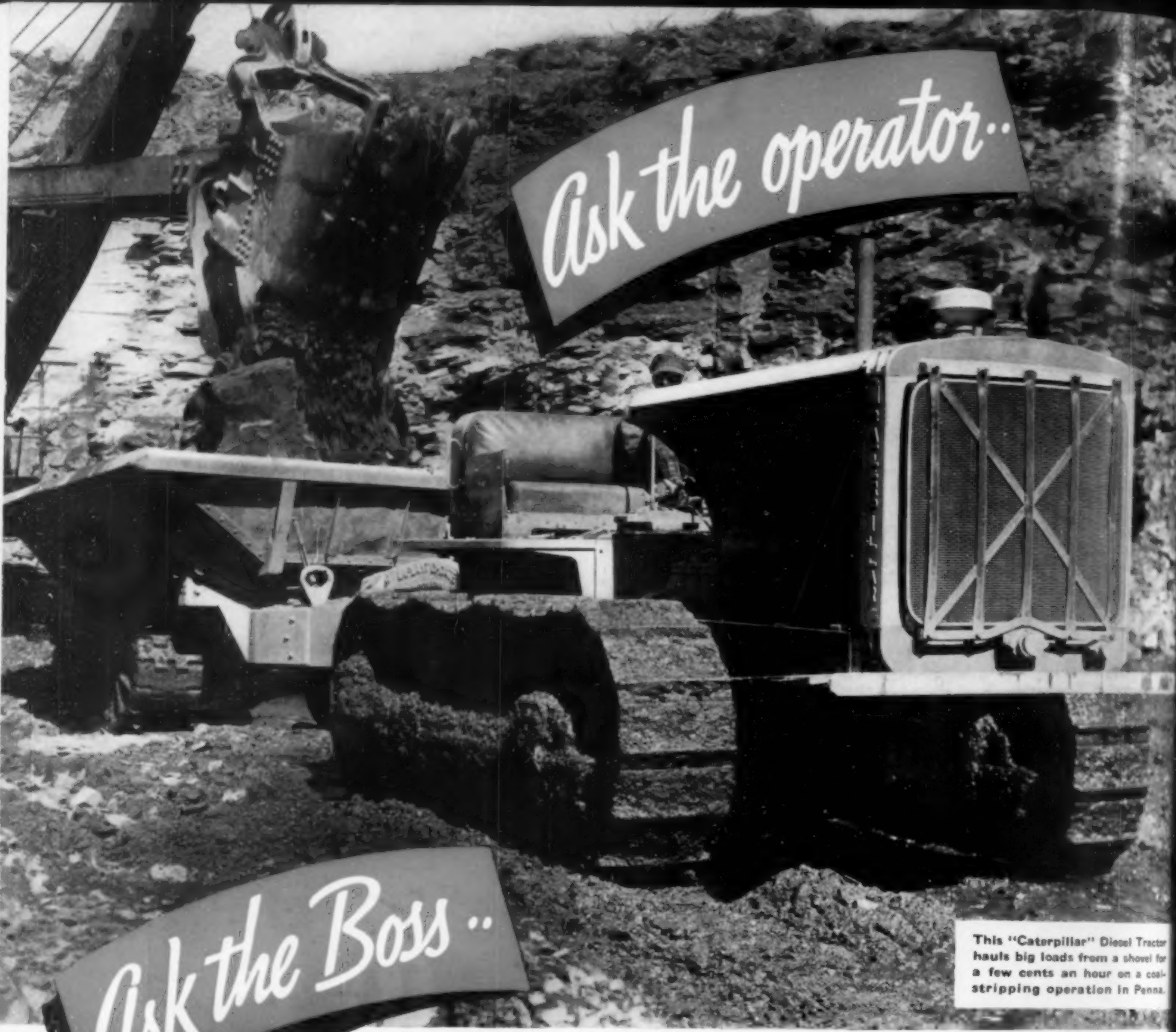
JUNE 1936



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Among Our Writers

PAUL BAUMANN has had over 22 years of experience in flood control and dam construction work, including 5 years in Europe and 17 years in this country. In the fall of 1934 he went with the Los Angeles Flood Control District on the construction of dams, channels, and spreading grounds. Since July 1935 he has been in charge of construction of San Gabriel Dam No. 1.

R. E. BAKENHUS, rear-admiral and public works officer of the Third Naval District, has served in the U. S. Navy for over 35 years. During the World War he served for a time as acting chief of the Bureau of Yards and Docks, and as manager of the Ship Yard Plants Division, Emergency Fleet Corporation. He had charge of building the 15-million-dollar naval armor plant at Charleston, W.Va.

LLOYD F. RADER received degrees of B.S.E. and M.S.E. in civil engineering at the University of Michigan, and has had experience in municipal and highway engineering work in Indiana, Pennsylvania, and Nebraska. He taught for 3 years at the University of Nebraska. Since 1928 he has been in charge of courses in highway and traffic engineering at the Polytechnic Institute of Brooklyn.

HARRY J. ENGEL graduated from Johns Hopkins in civil engineering in 1926. With the exception of the period from 1929 until 1932, when he was employed in power plant drafting, airplane stress analysis, and research work, Mr. Engel has specialized in bridge construction work with Modjeski, Masters, and Case. His experience includes both field and office work.

F. MERRYFIELD studied at Oregon State College and at the University of North Carolina, as well as abroad. Since graduation he has specialized in sewage treatment and stream purification work. He has been active in various committees on trade wastes, and now serves as a member of the research advisory committee to the state planning board. He is also secretary of the Pacific Northwest Sewage Works Association.

J. K. FINCH, after some early construction and architectural work, in 1911 accepted an interim appointment at Columbia University, of which he is a graduate, expecting to continue in construction later. He is now Renwick Professor of Civil Engineering and director of the summer school of surveying there. His course in structural esthetics, developed 15 years ago, is required of all civil engineering students.

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Number 6

The Function and Design of Check Dams

Discussing the Form of the Structures and Their Importance in Soil Erosion Control

By Paul Baumann

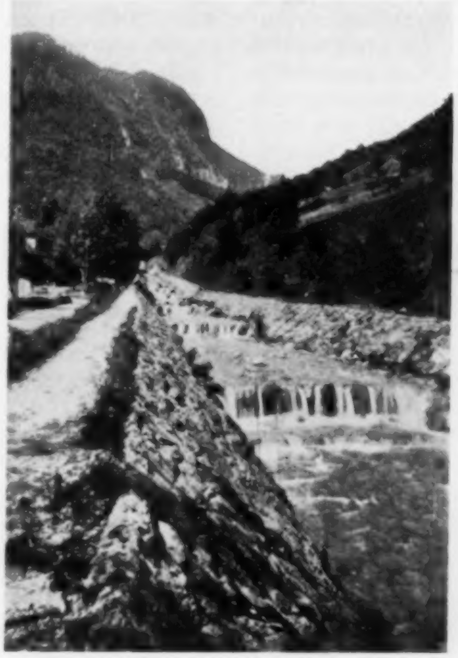
Member American Society of Civil Engineers

Junior Assistant Chief Engineer, Los Angeles County Flood Control District, Los Angeles, Calif.

Soil erosion control is an essential element of flood protection work. Soils lacking in stability hinder and in many cases preclude the growth of vegetation in sufficient amount to reduce runoff and prevent floods. Adequate check-dam systems, by stabilizing stream beds and side slopes, thus constitute the first line of defense against flood danger. Their initial action is to hold back the flow temporarily, causing some of the water-borne sediment to be deposited. The stream bed is thus raised and the side slopes flattened, whereas the depth remains practically unchanged. This causes a decrease in velocity and a further reduction in scouring action. The process is then repeated. This article, which is abstracted from Mr. Baumann's address before the Progressive Conference on Water Conservation held at Los Angeles on March 15, 1935, concludes with ten useful rules of a practical nature for the design of check dams.

The problems of flood protection and water conservation have gone hand in hand with the development of civilization, and some of the corrective methods used are as old as history itself. On the American continent, traces of check dams have been found on mountain streams which were once within the territories of the Mayas, Aztecs, and Incas. In Asia check dams were built by the Chinese probably in the earliest period of their civilization, several thousand years ago. Some of the earliest accounts of flood control engineering in Europe appear in Swiss history. One account refers to check-dam work designed and built by a township justice in the mountains above the Lake of Brienz after the catastrophic flood of 1499, but there is every indication that check dams were built in the Alps long before that time.

The best flood control method for any given case depends principally upon topographic conditions. Dams partly or fully solve the problem in the mountains by checking erosion, whereas in the valleys improved channels are of primary importance in reducing damage from inundation. In flood control work any dam is in effect a check dam, regardless of its height, in that it checks directly or indirectly the flow of, and the erosion caused by, a body of water moving downward on a slope. Thus at one extreme the typical debris dam is a check dam, while at the other the regulating storage dam is also a check dam.



Flood Channel Below Check-Dam System on Niederurner Dorfbach, Switzerland

This article will confine itself to the first type, that is, to the check dam in the more limited sense of the word.

FLOOD PROTECTION FROM CHECK DAMS IS INDIRECT

Check dams along a mountain stream form a system which must be carefully planned in its entirety before construction is begun. Profile, alignment, and cross-sections of the stream should be available for the preliminary design, the cross-sections covering enough territory to show the character of the side slopes. The survey should be accompanied by notes, sketches, and photographs describing features of particular interest such as rock outcroppings, character of soil, vegetation, wet spots, and slips. Adequate debris dumps and channels below the mouths of the canyons are indispensable in connection with check-dam systems, and if possible should be constructed first.

Unlike high dams, check dams provide no immediate or direct protection against major floods. Their effect is indirect in that they stabilize the stream bed and side slopes so as to hold the soil in place and enable vegetation to grow. The vegetation further stabilizes the ground and gradually reduces the relative runoff from the watershed. Such indirect flood protection is obviously more uncertain than direct protection as far as the time element is concerned. However, once established, indirect protection becomes permanent and automatic, and func-

View of Montrose-La Crescenta Area, near Los Angeles, Calif., at the Height of the 1934 New Year Flood

The Watershed in the Background Had Been Almost Completely Denuded Through Fire in the Preceding Summer

supported by suitable side structures, continued erosion will flatten the slope. Its stability will thus be improved, and it will become progressively less subject to sloughing.

Although erosion is the principal cause of the major changes in the topography of our mountains (the runoff which causes erosion being greater during wet periods), it is in periods of drought that the stage is set for this process by the destruction of plant growth through lack of moisture, over-grazing, spontaneous combustion, and similar causes.

It is impossible to separate conservation from flood protection. A system of check dams—and it must always be a system and not just a number—will collect debris behind and substantially up to the crest of each dam. During times of stream flow the interstices of these debris wedges are filled with water, which subsequently drains off at a rate and to an extent determined by percolation and drainage conditions. This may be termed direct conservation. In contradistinction, indirect conservation is effected through the stabilizing effect of the check-dam system on the side slopes and the enhanced capability of the top soil to hold pore water without sloughing. With stabilization comes heavier plant growth, which results in greater moisture absorption due to transpiration as well as seepage, and consequently reduces the runoff. At the same time, the decrease in evaporation tends to compensate for the increase in transpiration due to more luxuriant plant growth.

tions with a minimum of operation and maintenance.

On the face of it, and particularly to engineers who have never been in close contact with this kind of work, the statement that side slopes can be stabilized by means of check dams may sound too optimistic. In visualizing the process of slope stabilization it may help to remember that the slopes adjacent to a mountain stream are generally a product of decomposition and erosion, and are therefore just stable when in the condition under which they were formed, namely, when partly or fully saturated. If such a slope is undercut at the toe while in this critical condition, the slip surface, which is necessarily steeper than the ground surface, is unable to resist the downward weight component and the result is a slide which may extend up the slope for a considerable distance. If, on the other hand, the toe of the side slope is

The Importance of Soil Erosion Control

Although the beneficial influence of check dams on conservation cannot be denied, their main purpose is stabilization—conservation is more or less a by-product.

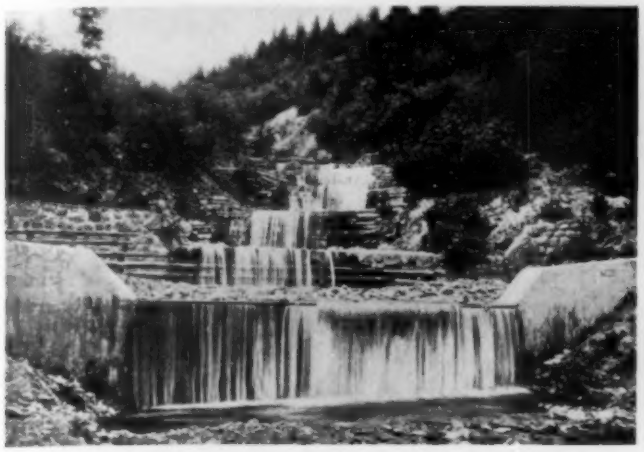
Typical Rock-and-Wire Dam for Small Streams

Typical Rock-and-Wire Dam for Larger Streams

Check Dams Constructed by Los Angeles County Flood Control District

Thus, not only is no flood protection possible without conservation, but no economical flood protection work is possible without soil erosion control. In fact, soil erosion control is the outstanding issue in the problem of permanent flood protection and flood control. Hand in hand with erosion control goes the growth of vegetation. The flood control problem in its comprehensive form is not solved unless there is stabilization of stream beds and side slopes, soil erosion control, and growth of sturdy vegetation.

A mountain stream tends to deepen its bed and thereby to cause the side slopes to become steeper and subject to sloughing as a result of the drag of water on the bed. This drag is proportional to the depth and to the slope. As long as the slope remains substantially constant, the drag varies in proportion to the depth, which explains the trench-cutting tactics of a stream. Cutting normally begins at points of maximum depth, which generally coincide with the stream line or the zone of maximum velocity. As soon as erosion begins, the depth increases and with it the cutting effect. This is particularly noticeable during a period of continuing increase in flow when the water surface often remains substantially constant while the depth steadily increases on account of scour. It is true that during continuing decrease in flow the stream has a tendency to reverse the process and to fill in the trenches previously excavated. However, once the material is loosened it moves more readily, and after such a flow the stream bed is usually deeper. This process is repeated in some degree during each flood and continues until the stream has cut into formations which resist further erosion.



This View, Taken in 1909, Shows the Timber Cribbing Which Was Constructed in 1904

The Timber Work Was Replaced by Concrete in 1913. Note the Progress of Reforestation

CHECK-DAM SYSTEM OF THE GÜRBE, SWITZERLAND

Check dams not only serve to prevent this cutting, but raise the stream bed and thereby flatten the slope. In a manner of speaking, they lift the stream out of a rut. When the bed is raised, the stream is generally widened and its energy dissipated by the fall of water over the check dam.

The flow of water in a stream is governed by laws of nature, the interpretations of which are known to engineers as physics, and more particularly as hydraulics. One of these laws which appears to be a rather close approximation of the law of nature concerning stream flow, states that the velocity is proportional to the two-thirds power of the hydraulic radius, multiplied by the slope to the one-half power.

Cross-sections of most mountain streams are approximately trapezoids with varying side slopes but with relatively narrow bases. With such sections it may be shown that for the same discharge the velocity is generally reduced by raising the stream bed and flattening the bottom slope through the construction of check dams, whereas the depth remains substantially unchanged. The reduction in slope may amount to as much as 50 per cent, and the reduction in drag is then approximately the same. This simple study shows, in a qualitative way at least, the effect of a reduction in slope and an increase in the width of the stream bed.

The question of whether or not stabilization of side slopes is possible, depends on the status of stream-bed erosion at the time the flood control work is begun. After erosion, water usually leaves vertical or nearly vertical banks. The height of the check dam required to stabilize given side slopes is determined in general by the height of the vertical portion of the banks, since the stream bed must be brought up to that height if the side slopes are to be kept from collapsing. Hence, the sooner flood control work is begun, the easier, as a rule, is the problem.

In many parts of the Southwest, no effort was made to control destructive erosion until recent years. While check-dam systems generally would correct the situation if properly designed and built, and if financially feasible, it is very doubtful whether much benefit could be expected from them in canyons of such depth and cross section as to defy appreciable widening of the stream bed and stabilization of the side slopes.

The slope at which a bank will stand when saturated is naturally governed by the material of which it is composed. According to research, the effect of drag on side slopes as compared to that on the bottom or on a level surface varies approximately as the ratio between the difference and the sum of the sines of the angle of repose above water and the angle of inclination of the side slope to the horizontal. The angle of repose of the material in banks above water is generally greater than that for the same material under water, except in the case of clean sand and gravel of uniform grain size, which has negligible capillary action or cohesion, as it is commonly called. Incidentally, this relation also furnishes the means of determining the necessary height of side-slope protection above the stream bed.

It is quite evident that the raising of the stream bed by means of check dams is not in itself sufficient to fully

stabilize the side slopes, but that additional structures such as shoulders and wing walls are necessary, unless the material in the side slopes and conditions in general are such as to ensure safety without this additional work. Wing walls, where required, should extend far enough upstream and downstream to protect the side slopes from erosion and to prevent percolation and piping around the ends of the dams. The stabilizing effect of a check-

LOWER PART OF THE GÜRBE FLOOD CHANNEL

dam system thus is comparable to the effect of ordinary trench timbering in unstable ground, with the wing walls representing the shoring and the check dam with its shoulders representing the cross bracing.

TEN RULES USEFUL IN THE DESIGN OF CHECK DAMS

Based as they are on some twenty years of experience in the San Gabriel Mountains and a century or more in the Alps, it is believed that under certain conditions the following rules will be helpful, although by no means indispensable, in the design of check-dam systems:

1. Check dams should be designed for silt and water in the stream bed and for a surcharge and impact due to mud flow, acting simultaneously.

2. Dams should be built of material having high shearing strength and resistance to the weather. If dry masonry is used, the smallest stones outside of fillers and chinks should be at least 1 cu yd in volume or 2 tons in weight. The parts near the crest and the shoulders should always be laid in mortar regardless of the size of the stones, unless other provisions are made to secure adequate bond.

3. Dams should be arched upstream whenever possible and the arch thrust spread by means of flaring abutments or wing walls, or both, unless the arch is anchored into rock or other material of adequate bearing qualities.

4. The overflow section should be wide and level and should be flanked by sloping shoulders of adequate height to prevent scour around the ends.

5. If side slopes are formed by material other than rock or ground of high density and bearing qualities, wing walls should extend far enough above and below the dam to adequately support the side slopes, to protect them from scour and to prevent piping around the ends.

6. The foundation of one check dam should be protected by the check dam or cross check below, so as to form a cushion the depth of which should not be less than one-third of the fall.

7. If heavy debris flows are expected, no appreciable downstream slope should be provided and there should be no artificial aprons below the spillways. Cushions are much more effective as a protection against scour.

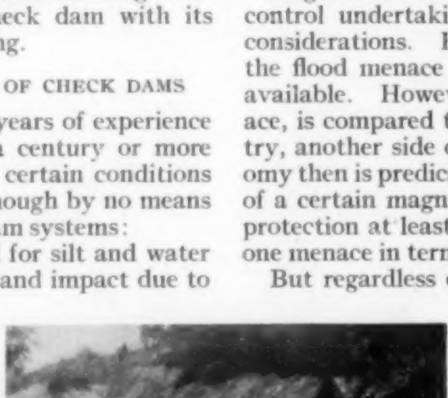
8. Dams and side walls should be properly drained.

9. The side hills should be properly drained where natural seepage flow is insufficient.

10. Check dams must be structures in the true sense of the word and must form an interrelated system. They should be of such height as to effect dissipation of energy during major floods and to stabilize the stream bed and the side slopes so as to permit natural or artificial reforestation of the watershed.

As to structural features, dimensions, and building material, no standards exist. These questions must be settled on the merit of conditions and by virtue of sound engineering judgment. There are perhaps few other fields that require as much intuition, engineering judgment, and engineering art, in addition to knowledge of the fundamental laws governing hydraulic structures, as the design and construction of a check-dam system. Nor are there many fields of engineering in which the lack of these essentials will be more quickly exposed.

Regardless of the technical talent available, any flood control undertaking is necessarily limited by financial considerations. Hence, the degree of protection against the flood menace is determined primarily by the funds available. However if this inner enemy, the flood menace, is compared to an outer enemy threatening a country, another side of the question will be evident. Economy then is predicated upon the calculation or assumption of a certain magnitude of menace and on the maximum protection at least cost. It is just as difficult to express one menace in terms of revenue as it is the other.



A HIGH CHECK DAM ON THE RUHSTELLIRUNS NEAR MOLLIS, SWITZERLAND

But regardless of how much money is expended, the protection and safety will always be relative, never absolute. This is as true of check dams as of other structures, except that the former, by the law of averages, are more likely to be exposed to formidable dynamic or mass forces than most structures.

To build a check-dam system that would be immune to onslaughts from landslides, boulders, and mud avalanches of the sort produced by a cloudburst on a precipitous watershed almost completely denuded by fire, drought, or exploitation, is well-nigh impossible within ordinary budgets. I do not believe that there is any check-dam system anywhere which would not suffer damage or even partial destruction under such circumstances. Engineers may well remember what the French philosopher and mathematician, Pascal, said almost three hundred years ago. He said that two natural phenomena would never be quite understood by men—women and water.

Public Works of the Navy

Some of the Accomplishments and Responsibilities of the Civil Engineer Corps

By R. E. Bakenhus

Member American Society of Civil Engineers
Rear-Admiral, Civil Engineer Corps, U. S. Navy, New York, N.Y.

Four Hangars, U. S. Naval Air Station, Pensacola, Fla.

Published tables show that there are in the U. S. Navy today over 600 vessels, including 15 battleships, 4 large aircraft carriers, 94 submarines, 200 destroyers, 35 cruisers, and numerous merchant types and smaller vessels. Aircraft also form a very important part of the naval establishment. The construction and maintenance of the necessary shore stations, including harbor development; shipyards; repair shops; graving and floating docks; marine railways; submarine bases; air, ordnance, and radio stations; oil and coal supply stations; and buildings for housing, training, and hospitalization of personnel, are the responsibility of the Civil Engineer Corps of the Navy. The provision of power for the shore stations is also a part of the Corps' responsibility, where such power is generated at the Navy's own central plants. This article, abstracted from Admiral Bakenhus' address made November 20, 1935, before the Metropolitan Section of the Society, describes some interesting phases of the Corps' activities.

The U. S. Navy has a record of which it may well be proud, and has been well thought of by our people. It serves in the various waters of the world but obviously it cannot exist without a supporting land establishment. There is not much glory connected with the work of the shore establishment. There is, however, a tremendous pride shown by the various yards and stations in the results of their work. When a ship is built, proceeds on her cruises, and successfully performs her functions, it is a satisfaction to the men who built her and contributed to her success.

Back of the Navy is the civil engineering profession which has provided the basic plant for it all. In fact, the work of the civil engineer comes first—before a ship can be built, before a man can be trained, before naval stores can be housed or planes be operated. It is the purpose of this paper to show the relation of the civil engineering profession to the Navy—in what way it contributes to the Navy's success.

A commissioned Civil Engineer Corps was established at about the close of the Civil War. The Corps has grown and under the law may now have 110 officers ranking from junior lieutenant to rear admiral, the rank, pay, and conditions of service being the same as for other Navy officers. Formerly, appointments were made entirely from civil life after thorough competitive examinations. Later practice has been to select qualified graduates of the Naval Academy, give them a three-year postgraduate course in civil engineering, and then commission them in the Civil Engineer Corps. There is also a Corps of Reserve Civil Engineers, who are commissioned from junior lieutenant up to lieutenant commander. There is no active duty and no pay except when a reserve officer occasionally has active duty for a two-weeks' period. To be a reserve officer is a distinction, and the officers are subject to call in case of war or other emergency.

The Navy utilizes public harbors and anchorage facilities where practicable, but there are certain harbors such as Pearl Harbor near Honolulu, and the waters at navy yards, where the Navy through the Civil Engineer Corps does its own harbor development, including dredging for channels and anchorages; construction of moorings, piers, and wharves; placing of lights and buoys; and provision of whatever other facilities are necessary.

Although the Navy calls upon private establishments for a part of its shipbuilding, it does practically all the repair and maintenance work itself. The engineer is thus called upon to build an extensive naval industrial establishment—foundries, machine shops, ship-fitters' shops, boat shops, boiler shops, building ways with overhead crane service, floating cranes, and rail and other transportation systems. To maintain and repair ships, there are in addition repair piers, graving docks, floating docks, and marine railways for hauling ships out of the water. Storehouses are also necessary not only for the repair and maintenance of ships, but also to supply the crews with food and clothing.

MANY DIFFERENT KINDS OF BUILDINGS REQUIRED

Numerous buildings are required for the personnel of the Navy. There are training stations for the new re-

cruits, receiving stations where men who have already been trained and who are awaiting assignment or transfer are housed, the Naval Academy, the Naval War College, and the Naval Observatory. There are barracks for the marines as well as hospitals, dispensaries, prisons, and even cemeteries. There are submarine bases, air

FLOATING DRY DOCK "DEWEY," AT CAVITE, P.I.

stations, ordnance stations, and radio stations. All the details of building construction have been worked out from the standpoint of hygiene and sanitation as well as from that of economy. At strategic points, under Navy control and on Navy property, there must be local or reserve supplies of fuel oil, Diesel-engine oil, gasoline for aircraft, lubricating oils, and other supplies.

There are over 300 separate shore stations. Some of these are inactive and some might well be grouped as a single station. Nevertheless the list is imposing and gives an idea of the public works problems of the Navy. There are about 10 large navy yards on the east and west coasts and in the Pacific. There are some 12 important hospitals. Altogether there are some 12 to 14 important ordnance stations.

In the outlying regions, the Navy has stations at St. Thomas in the Virgin Islands (now inoperative); at Guantanamo, Cuba; at Cristobal and Balboa in the Canal Zone; in the Hawaiian Islands; on the island of Guam; at Tutuila, Samoa; at Olongapo and Cavite in the Philippines. There are also minor stations at points in Alaska.

The Bureau of Yards and Docks, under which the Civil Engineer Corps operates, and which under the law must have as its chief an officer of the Civil Engineer Corps, requests appropriations for, and designs and builds the public works of the Navy. The general features and operating requirements are laid down by the particular bureau which is to use the building or activity concerned. The Bureau of Yards and Docks is divided into various sections whose primary duty is to keep informed of the public works requirements of the various other bureaus and branches of the Navy, and then to design and execute the necessary projects. The officers of the Civil Engineer Corps must be generally well versed in all these matters, since they have both bureau duty and field duty. This organization is specialized and highly developed, so that when a request to fulfill some need comes in, the finished product can be erected promptly in any part of the globe.

The Navy has consistently followed the policy of keeping out of civil or non-naval affairs whenever possible, and with few exceptions the Corps of Civil Engineers has confined its operations to Navy public works. However, an officer of the Civil Engineer Corps, Admiral Endicott, Past-President of the Society, was a member of the earlier Isthmian Canal Commission, and another officer, Admiral Rousseau, was a member of the commission that built the Canal. Officers of the Corps are officials of the civil government of the Island of Guam and of that at Samoa. During the occupation of Santa Domingo and Haiti, officers of the Corps were in charge of public works improvements.

It will be of interest to present a selected few of the problems that have arisen in the experience of the civil Engineer Corps to illustrate the variety of its activities.

PROVIDING WATER SUPPLY FOR IONA ISLAND

The Navy has an ammunition depot on Iona Island in the Hudson River just below the Bear Mountain Bridge. The original water supply at the depot—derived from roofs, wells, and a small reservoir that was used both for catchment and storage—was insufficient. The possible new sources of supply included deep wells, Hudson River water, the watersheds of the east bank of the Hudson, and the watersheds of the Palisades Interstate Park on the west bank areas, and a tap on the West Point supply. All these were discarded for important reasons.

Investigation showed that an additional supply could be obtained on the island itself from undeveloped areas and from additional roof surfaces. Tables of probable rainfall were prepared and contour surveys were made to show the rainfall area tributary to a proposed additional reservoir. Runoff was taken at 45 per cent, having in view the uncertainties of the fissured rock formation of the drainage area. The driest three years of an 88-year period—1925, 1926, and 1927—were taken as the basis of the design. Consumption was estimated from reliable station records. By plotting input against consumption and allowing for evaporation and loss, a determination was made of the storage required to tide over the driest three-year period that might be expected to occur.

The augmented collecting system consists of pumped wells, of roof drainage, and of two reservoirs each with a catchment area. As the reservoirs are of the low-level type, the collection system includes low-pressure pumps which lift the water to the storage tanks. The storage system consists of two

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NEW NAVAL HOSPITAL AT PHILADELPHIA, LOOKING NORTH

steel tanks mounted on higher ground than the reservoirs. These tanks hold all the water needed to tide over a dry period. The two surface reservoirs, primarily intended for catchment, are also available and are used for reserve storage.

For the distribution system, high-pressure pumps raise the water from the storage tanks to the steel standpipe, whence the water is distributed by gravity through the usual piping system. The raw water on the way to the tanks is treated with soda ash solution in order to counteract its slightly corrosive qualities, and it may also be prechlorinated. In any case the water is chlorinated when it is withdrawn from storage and just before it reaches the distribution pumps. After several years of experience the results have been found satisfactory. The water supply is both ample and potable. This small supply system has in it many of the elements of much larger systems, including problems of sanitation of watershed, rainfall, runoff, storage, treatment, and distribution. The construction work even involved a fairly heavy rock tunnel.

Construction of the Naval Armor Plant

Begun in 1917, the Naval Armor Plant at Charleston, W.Va., was the largest single public works enterprise ever undertaken by the Navy with day labor; in fact, it is one of the largest of such enterprises ever undertaken by the Navy in one operation. The Bureau of Ordnance designed the technical equipment for ordnance manufacture, and the Bureau of Yards and Docks designed the public works features.

The machine shop is a building 560 ft long and 324 ft wide. Most careful studies and designs were made for natural lighting through specially designed monitor-type skylights. A novel method of design was used to secure even distribution. The lighting is so good that on a day of moderate light, a newspaper can easily be read in any part of this building. The units of the armor plant consist of a steel manufacturing plant with open hearth and electric furnaces, a forging and heat-treatment plant, a machine shop, and a gun-shrinking pit nearly 100 ft deep. The plant was equipped to handle armor plate of great thickness.

Altogether, the plant cost about $15,000,000. The site occupied about 200 acres. After the plant had been designed and built complete, there came the Limitations of Armament Conference of 1921, with the result that the building of further battleships was postponed and the plant was closed. It has remained closed ever since.

Graving Docks Present Problem

For well over a hundred years the Navy has placed reliance on its graving docks. The granite docks at the Boston and Norfolk navy yards, completed in 1833 and 1834, are still in use. The old granite dry dock at the New York Navy Yard followed in 1851 and is still in excellent condition. These three granite docks were well built and are a monument to Loammi Baldwin and other engineers of that day.

Machine and Electric Shop, Puget Sound Navy Yard

The modern docks of timber and concrete have not lasted so well. The timber dry dock, which some engineer of the day referred to as a clapboarded hole in the ground, was very much in vogue some 40 to 45 years ago. However, after building a number of timber docks, the Navy adopted the concrete dock in the belief that it would far outlast the timber one. This has not altogether been borne out by experience. The No. 3 dry dock in the New York Navy Yard, built of timber in 1897, is still in excellent condition after the wood work above mean low water level has been replaced with concrete, while No. 2 dry dock, originally of wood construction but changed to concrete about 1901, has been practically rebuilt on two different occasions.

A concrete graving dock puts concrete material to a very severe test. Whether there is a ship in the dock or not, the water is usually kept pumped out. This means that there is water pressure on the back of the walls and a tendency for the water to percolate through. The evaporation of moisture on the exposed face of the wall further tends to induce the flow of ground water through the walls, possibly some of it salt water. Evaporation on the surface deposits dissolved salts in a nascent state. In the case of the portland cement mortar in the joints

Administration Building, U. S. Naval Air Station, Pensacola, Fla.

Recreation Building, U. S. Naval Air Station, Pensacola, Fla.

of the new granite-lined dock at Boston, the mortar became so soft after about ten years that in places a lath could be inserted between the stones to a depth of from 2 to 3 ft.

Because of deterioration from this and other causes, No. 2 dry dock at the New York Navy Yard was recently rebuilt. The work was all done by force-account labor with two minor exceptions. It was necessary to unwater the entire body of the dock, and this could be accomplished only by building a steel cofferdam. The funds were so limited that most careful consideration was given to the cofferdam specifications. Contract work was decided on as the Navy Yard did not have the driving equipment, and further, because if sheet piles were purchased, used, and then sold, the credit would go into the miscellaneous fund of the Treasury and not to the job. Borings and soundings were made and the difficult cofferdam was successfully built by a local firm.

BACHELOR OFFICERS QUARTERS (UNDER CONSTRUCTION) AND MARINE BARRACKS, QUANTICO, VA.

In rebuilding the dry dock, a number of improvements of value were made. The head wall was formerly of the same cross-section as the body, shortening by 20 ft the length of the ship that might be placed in the dock. In rebuilding, the stepped end wall was replaced by a heavy reinforced concrete vertical slab reacting against the side walls and the bottom of the dock.

The suction mains were in such bad condition and leaked air to such an extent that during the present reconstruction a new direct lead of cast-iron pipes was decided on. The old floor system had provisions for subfloor drainage, but the drains had become inoperative owing to deposits of harbor mud. Floor drainage was simplified by the new location of the pump suction pit at the middle of the dock. The system is so designed that the velocity should prevent mud deposits.

FLOATING DRY DOCKS, MARINE RAILWAYS, AND MISCELLANEOUS STRUCTURES

A floating dry dock lifts ships out of the water, and must be moored in deep water so that it can be lowered by flooding to permit the ship to be floated in between the side walls. The depth of water for a large dock must be some 20 to 26 ft more than the draft of the ship. As soon as the ship is in position the pumps are started; the dock rises, and the blocks make contact with the bottom of the ship. Then both the ship and the floating dock rise. The pumping continues until the deck of the pontoon is well above the water surface.

The weight of the water pumped is equal to the weight of the ship plus the weight of a part of the dock itself, with a certain allowance for beginning and stopping the operation. A contrary principle applies in the case of the graving dock, where the amount of water to be pumped is less with a large ship that nearly fills the dock, and is much more with a small ship. The floating dry dock is easier to operate, and the ship is in a better position for work as there is more light and air.

There are two general systems for designing a floating dry dock. One contemplates a floating structure built of loosely connected sections which can transmit no longitudinal stresses, and requires that the sections of the dock be pumped out an amount proportional to the load placed on them by the ship; otherwise the ship would be put under stress. The other system contemplates a rigid dock structure which will take longitudinal stress and which may be pumped uniformly short of the point where excessive or dangerous stresses would be developed in the dock or the ship.

The Navy has generally preferred the graving dock to the floating dry dock and now has only three important floating dry docks, with one or two more in contemplation. There are 27 graving docks. One of the photographs shows the floating dry dock *Dewey* with a vessel in it. The framed structure in the foreground is merely a bridge connecting one side with the other. It may be swung out to permit a ship to enter.

RECEIVING BARRACKS AT PUGET SOUND NAVY YARD, BREMERTON, WASH.

The marine railway offers a third method for getting ships out of the water. The Navy has a number of these, most of them acquired in the last 25 years. The marine railway consists of an inclined runway, a part below water and a part above, usually built on piles. The sloping ways have a roller path and a set of rollers on which the cradle travels. The working floor of the cradle is nearly horizontal. It is rolled down the incline into the water and when at sufficient depth, the ship is floated into position over the blocks on the cradle. Due to the sloping roller path, the depth of water under the stern of the ship is considerably more than the draft of the ship itself. The cradle is pulled up the incline by means of a heavy chain and "wildcat," and as the cradle rises, the blocks support the ship and lift it out of the water.

Marine railways in the Navy are used principally for destroyers, submarines, and smaller craft. They are adapted to ships of about 3,000 tons displacement and less. If the site is suitable, the marine railway is cheaper to build than either the floating dry dock or the graving dock, and the operation is much faster. The marine railway offers an advantage even over the floating dock in that the light and air are better and there is no waiting for water to drain off the floor as in the case of floating or graving docks.

One of the photographs [on the cover of this issue] shows the hammerhead type of crane. It is very efficient

and very economical to build and operate. The crane covers a considerable ground area outboard of the ways, which can thus be utilized for erection purposes. This type of crane differs from the overhead bridge type in that it covers only a limited radius. The service in transporting material is performed by rail on a track which surrounds the ways, and merely means a slightly longer rail haul than with the overhead type of crane. The large revolving tower crane shown has a lifting capacity of 350 tons and is intended to lift a gun turret complete out of a battleship and set it on a pier for whatever operations may be needed. It will also permit a turret to be erected on the pier and placed on board a ship in one lift.

AIR STATIONS

An air station for heavier-than-air craft requires a field, with treated surface for take-off and landings, ramps for hauling seaplanes out of the water, hangars of various types and sizes, quarters for the officers, barracks for the men, repair shops, storehouses, and instruction rooms.

One of the photographs shows four hangars at Corry Field, U. S. Naval Air Station at Pensacola, Fla. At Pensacola is situated the largest air-training station of the service, where the fliers are given their final courses. Other photographs show the administration building and the recreation building at this station.

Still another photograph shows a bird's-eye view of a part of the Marine Corps base at Quantico, including a typical barracks building. It indicates how large and varied are the requirements of such an establishment. The machine and electric shop and the receiving barracks at the Puget Sound Navy Yard are also illustrated.

SOME POWER PROBLEMS OF THE NAVY

By law the navy yard power plants were centralized 30 years ago under the Bureau of Yards and Docks. Prior to that, each bureau had its own power plant, and in the Philadelphia Navy Yard there were as many as seven independent plants. Now there is a central plant for all activities. The hospitals, supply bases, training stations, and other types of shore stations all need electric current, heat, and other services, depending on the climate and location, and each has a central plant. In some cases, however, it is advantageous to purchase current.

The large navy yards utilize compressed air, hydraulic power, high- and low-pressure steam for industrial purposes, steam or hot water for heating (except in tropical locations), electric current for lighting and for power. Power for these services is produced at a central plant. The distributing systems for alternating current, direct current, hydraulic power, compressed air, and steam extend for miles throughout the yard. The cost of production and distribution is known as power expense and is determined monthly. The lower the annual expense for power, the more the Navy has for expenditure on ships, which is what Navy men live for.

The lowest unit cost for any given service does not necessarily give the lowest overall cost. It was found, for instance, that operation of power hammers by steam was not as economical as operation by compressed air, which is normally much more expensive. This was because the exhaust steam from the compressors in the central power plant was used for heating, thus saving more than the cost of compressed air for the hammers.

Similarly, bleeder steam, that is, steam at low pressure, taken out of the turbo-alternators, is used for heating, leaving only a small part of the steam to go to the condensers. The steam does work at high pressure; the heat which remains in the steam is then used in the heating system. This results in a lower overall cost than if the turbines were run full condensing, and high-pressure steam were used for heating.

Therefore, when the problem arises whether a navy yard should produce electric current or purchase it from a utility company, the total annual power expense under each of the two sets of conditions must be fully determined. The figures must take into account the length of the heating season, the total heating load, the total electric output, and the shape of the hourly curve for heat load and for electric load. The electric current is produced in quantity exactly as needed, and the "bleeder" steam cannot be stored while waiting for a heating demand.

AIR VIEW OF U. S. NAVY YARD, WASHINGTON, D.C.

Every situation must therefore be studied in great detail on its own merits and a decision reached accordingly. Amortization, depreciation, and interest must be charged against the government plant, although they are not actually paid for by the plant. One of the factors is of course the price charged for current by the utility company.

At the close of the World War it was found that costs, including those of power produced in navy yards, had risen enormously. As a part of the demobilization, it was one of my duties to bring the power costs back to normal. The entire system of supervision was changed to bring this about. Instead of judging the efficiency of the yards by the unit cost of electricity and other power, as was done formerly, it was decided to judge each yard by the total overall annual cost.

It was not only in operating the plant and distribution system that savings were made, but also in utilization by eliminating waste and unnecessary use of power. Supervision of the heating of large shop buildings resulted in worth-while savings. In one yard a saving of about $240,000 out of $1,000,000 was made in the first year. In another yard the total power expense of $600,000 in 1922 was reduced to $300,000 by 1932, and this with no substantial change in the work load. The use of exhaust steam and bleeder steam for heating helped to bring about this result. A thousand other economies of a minor and a major character have also been practiced in the navy yards in order to gain these results. Such problems and the opportunities to solve them make life strenuous and interesting in the naval service.

Safety Factors in H

Presenting a Résumé of Those Features

By Lloyd F. Rader
Assistant Professor of Civil Engineering

***Responsibility** for the frequency of automobile accidents, particularly in rural districts, cannot be placed entirely upon drivers as long as hard-surfaced roads and powerful motors make higher speeds continually possible. The highway designing engineer, says Professor Rader, should assume the responsibility of providing every requirement for safe operation of modern high-speed traffic. The importance of such safety features should therefore be emphasized by teachers of highway engineering. Among the features referred to are adequate width*

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An Example of Good Design of Traffic Circle Islands
View of Intersection of Routes 25 and S-28, near New Brunswick, N.J.

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Flashing-Light Signals Are Safety Factors at Railroad Crossings
On U. S. Route 17 in Virginia

Anyone who has studied traffic accident statistics for the last few years cannot fail to be impressed by the seriousness of the safety problem. The increase in the number of accidents on rural highways is undoubtedly due in large measure to increased speeds of operation of motor vehicles. The limit of such speeds seems not yet to be in sight, which aggravates the problem still further.

It is not sufficient to say that most accidents are due to the faults of drivers; the highway engineer also has important responsibilities in designing highways for safe operation. While safety factors are often thought of as a subordinate element in the teaching of highway engineering, I believe they are just as essential as any of the other basic factors.

Higher vehicular speeds have increased the importance of adequate sight distance enormously. Drivers approaching at high speed need advance warning of unfavorable conditions at great distances and also require longer distances to overtake and pass other cars. Only a few passing operations can be carried on safely in a mile of two-lane highway under conditions of high speed, and the traffic capacity of a two-lane road is therefore reduced as the speed of vehicles is increased beyond a certain point. If it is impossible to increase sight distances, additional lanes must be provided.

Problem of the Three-Lane Highway

Much discussion has centered around the three-lane highway as a means for increasing traffic capacity and permitting higher speeds. Many objections to the three-lane highway have been raised. For example, it is difficult to determine which driver has the right of way when collisions occur in the middle lane. Again, long sight distances are necessary for safety. Nevertheless three-lane highways are being constructed where it is not financially possible to construct four lanes. A. N. Johnson, M. Am. Soc. C.E., in his article on "Traffic Capacity" (*Proceedings, Highway Research Board,* December 10–11, 1931), has shown that while the addition of one lane increases the width of a two-lane roadway but 50 per cent, the capacity is increased 100 per cent. He notes, however, that "There seems to be very general agreement among those who have observed the operation of three-lane roads that as traffic increases the hazards increase in a greater ratio than is the case of the two-lane or the four-lane roads...." From the standpoint of safety it would appear advisable to construct four-lane roadways where two lanes are inadequate. The present tendency toward high speeds further indicates the desirability of increasing the width of lanes to 11 or even to 12 ft. Increase in speed also makes it important that all roadways have wide, flat, well-compacted shoulders to provide space for avoiding collision, changing tires, making repairs, or parking.

It is dangerous for a motorist to pass abruptly from a section having long sight distances to a sharp curve having a short sight distance. In other words, sight distances should be as uniform as possible over a given

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Part of Newark–Sussex Highway in Northern New Jersey
Roadways Divided by Medial Strips Are a Recent Development

Highway Design

Over Which the Engineer Has Control

Assoc. M. Am. Soc. C.E.
Polytechnic Institute of Brooklyn, Brooklyn, N.Y.

and number of traffic lanes, increased sight distances, reduction of curvature and grades, better-designed railroad and highway grade separations, provision of foot-walks and improved means for protection of pedestrians, and wider use of intensive highway lighting. This article is a somewhat condensed version of the paper prepared by Mr. Rader and delivered by H. P. Hammond, M. Am. Soc. C.E., at the annual meeting of the Society for the Promotion of Engineering Education which was held at Atlanta, Ga., on June 25, 1936.

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PROPERLY DESIGNED RAMPS ARE AN ESSENTIAL FEATURE OF A GRADE SEPARATION

Intersection of Teaneck Road and Route 4, New Jersey

stretch of highway. Where a number of unfavorable conditions exist close together, as in mountainous country, a motorist will operate his car at a slower speed than on a road having but occasional stretches with short sight distances. The sight distance on horizontal curves may be improved by "daylighting."

As explained by E. C. Lawton, in "Design Principles and Travel Speeds," (CIVIL ENGINEERING for March 1935) it is the practice of the Division of Highways of the New York State Department of Public Works to compute the sight distances for each station of the project and to plot the computed values directly below the profile on the plan and profile sheet. The effect of both horizontal and vertical curves is indicated.

LIMITATIONS OF HORIZONTAL AND VERTICAL CURVATURE

The design of horizontal curves has become increasingly important as speeds have increased. Centrifugal force varies directly with the square of the speed and inversely with the radius of curvature ($F = \frac{WV^2}{gR}$). Centrifugal force can be counteracted by superelevation and by frictional resistance between tires and pavement, but at high speeds the frictional resistance is of more importance in resisting centrifugal force. Superelevation of public highways must be limited to avoid slipping of slow-speed traffic on ice-coated pavements. Oregon uses a maximum superelevation of 0.13 ft per ft of width of pavement.

Curvature thus imposes definite limitations on speed. To indicate the direction that thought in this matter is taking, reference may be made to a recent article, "Highway Design for Speeds Up to 100 Miles per Hour" (*Engineering News-Record* for May 23, 1935), by R. H. Baldock, State Highway Engineer of Oregon, in which it is stated that the limit of curvature for a speed of 100 miles per hour is 3 deg. Such curvature is what we have been accustomed to think of for trunk-line railroads.

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PEDESTRIAN-ACTUATED SIGNAL IN WASHINGTON, D.C.

After Pushing Button, Pedestrians Await Green Signal

In the past, transition spirals have not been considered necessary on highway curves, since at speeds of 40 to 50 miles per hour drivers had little difficulty in controlling the path of their vehicles, which could describe spirals within their own lanes of travel. As pointed out by R. A. Moyer, Assoc. M. Am. Soc. C.E., in "Skidding Characteristics of Automobile Tires on Roadway Surfaces, and Their Relation to Highway Safety" (Bulletin 120, *Iowa Engineering Experiment Station*), the required length of transition spiral varies directly as the cube of the speed, and the "shift" toward the center of the curve which it is necessary for the car to make increases as the sixth power of the speed. This shift is the distance at the end of the transition spiral that the circular curve is moved toward its center. Curves on primary routes should therefore be constructed with long spiral easements. In the case of existing unspiraled curves, widening of the pavements will be necessary to make them safe for high-speed travel.

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RAILROAD-HIGHWAY GRADE SEPARATIONS OF EARLIER DAYS INTRODUCED MANY TRAFFIC HAZARDS

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A RAILROAD UNDERPASS ON THE MT. VERNON MEMORIAL HIGHWAY IN VIRGINIA

Modern Grade-Separation Structures Are Often of Pleasing Appearance

separated by a 5-m planted strip.

In connection with the construction of high-speed trunk highways, the recently developed "freeway" should be mentioned. This is a highway for express traffic to which the abutting property has no right of access. It is designed to prevent the costly express highway from becoming, to a large extent, a local street, to prevent "ribbon development," and to ensure that the through highway will remain an express highway.

HIGHWAY SIGNS AND GRADE SEPARATIONS

A great deal has been said and written in the matter of highway signs and signals. Signs and signals are aids to safety on any and all highways, but they cannot take the place of safety "built into the roadway." The recent trend toward reflecting signs, illuminated by the headlights of approaching cars, is a decided advance in safety provisions. The desirability of standardization of signs and signals is so obvious as not to require discussion. Two types may be mentioned—signs marking the beginning of a divisional strip and flashing signals which warn of grade crossings.

While the provision of traffic circles has greatly improved safety conditions at many important intersections, the design of the islands at a number of these intersections is defective. In this connection A. H. Vey, traffic engineer for the State of New Jersey, in his article on "Highway Facilities and Motor Vehicle Accidents" (*Roads and Streets* for June 1934), stated:

"Accident experience at some of the circles constructed along New Jersey's highways indicates that greater attention should be paid to the design of the island. Its location should be such that adequate advance warning is provided in order that motorists traveling at high

As regards vertical alignment, modern passenger automobiles are not greatly affected by ordinary grades, provided adequate sight distances are provided at their summits. However, the large, heavy pay loads which motor trucks must carry necessitate low speeds on hills. It seems impossible for drivers of passenger cars to resist attempting to pass slow-moving trucks on hills in spite of unfavorable or even dangerous conditions. The construction of additional outer lanes on hills may improve this situation. On heavily traveled highways, however, slow-moving vehicles using the marginal lane may find themselves forced to stop at the point where it ends and wait for a chance to get back into the regular stream of vehicles. For this reason trucks often choose to remain in the high-speed inner lanes. Thus the provision of an extra lane on hills may not have the desired result of increasing safety.

Separation of a roadway into lanes by means of lines or markers tends to organize traffic into streams, thus making effective use of the roadway and promoting safety. Paint applied either in continuous lines or in dots is generally used for this purpose. However, the most recent practice is to construct divided roadways for high-speed, heavily traveled highways. One of the photographs shows the most recent practice in New Jersey in this connection. A divisional strip from 10 to 30 ft wide offers a place of greater safety for pedestrians and renders it possible for vehicles making left turns at intersections to await in safety an opportunity to cross streams of through traffic. Such strips also give space for planting shrubs along the medial line to intercept the rays of headlights. Some 1,500 km of highways have been constructed in Germany on the basis of two $7^1/_2$-m roadways

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SODIUM-VAPOR LAMPS OF 10,000 LUMENS LIGHT AN UNDERPASS AT SACRAMENTO, CALIF.

speed may have a sufficient opportunity to slacken their speed before reaching the island to insure their safe passage around the circle."

Poor design of islands has unfortunately been followed in the traffic circle at the junction of Routes 21, 25, and 29 on the Newark (New Jersey) Meadows, shown in one of the photographs. An especially bad feature of this design is the left turn into a high-speed highway (Route 25, shown in the background) which is almost completely masked by an earth embankment. The traffic circle at the intersection of Route 25 and Route S-28, just outside of New Brunswick, N.J., has a better design of the islands.

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Facilities for Pedestrians Are Being Provided to an Increasing Extent

Separate Archway for Footpath on Westchester County Parkway near New York, N.Y.

Mr. Vey also reports that at the first cloverleaf constructed in New Jersey, 11 accidents were reported in 1932. In every one of these cases the accident occurred at a point where the entrance or exit ramp intersected the main highway. Properly designed entrances into ramps are needed, and proper signs are an important adjunct of the design. The grade separation at the intersection of Teaneck Road and Route 4 in New Jersey is an excellent example of good design of entrances and exits of ramps. An outstanding example of separations of highways is at Fort Lee, on the New Jersey approaches to the George Washington Bridge, where three levels of roadways are provided.

Railroad–highway grade separations have become increasingly important owing to increased speed of motor vehicles and of trains. In designing these structures, attention should be paid to both safety and appearance. Grade-crossing separations of an earlier day too frequently embody narrow roadway, sharp curvature, poor sight distance, and an unattractive plate-girder structure. All these defects occur at the location shown in one of the photographs. Good modern practice is typified by adequate width, divided roadways, lane markings of white cement, easy curves, good sight distance, directional sign for divisional center strip, and attractive concrete structures. The Richmond, Fredericksburg, and Potomac Railroad grade-separation structure on the Mt. Vernon Memorial Highway in Virginia is shown in one of the illustrations. It is of pleasing appearance, and the divided roadways are adequate in width.

Providing for the Safety of Pedestrians

We have been slow in providing sidewalks and footpaths for pedestrians on rural highways, but recent developments indicate that the design of facilities for pedestrians will be an important part of the highway work of the future. In many cases well-designed highways are provided with divided roadways, lighting, and signal control for vehicular traffic, but have no facilities for pedestrians. The grade-separation structure of the Westchester County Parkway system shown in a photograph illustrates the construction of a separate arched opening for the footpath.

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Ballston Road, Schenectady, N.Y., Illuminated by 4,000-Lumen Sodium-Vapor Lamps

Protection to pedestrians is provided at some street intersections by the "pedestrian-actuated" signal which permits a pedestrian to press a button to change the signal to red against vehicular traffic. Construction of tunnels under heavily traveled thoroughfares is needed in many locations to provide safe crossings for pedestrians.

One of the greatest sources of traffic interference is the existence of frequent street intersections in urban and suburban areas. In modern town planning, as exemplified by Radburn, N.J., the distances between intersections on thoroughfares are increased by making the blocks excep-

tionally large, about one-half mile long by one-quarter mile wide. Access to the residences in the block is afforded by a limited number of secondary streets with cul-de-sac streets branching from them, which discourages through traffic from entering. Thus the residential areas are protected from the danger and inconvenience of through traffic. Another feature of the Radburn plan is the segregation of pedestrian walks from vehicle pavements. Underpasses on main paved roads provide additional pedestrian protection.

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JUNCTION OF ROUTES 21, 25, AND 29, NEAR NEWARK, N.J.
The Left Turn Into Route 25 (in the Background) Is Unfortunately Almost Completely Masked by an Embankment

PROGRESS IN LIGHTING HIGHWAYS

One of the most promising recent developments in improving safety is that of highway lighting. Statistics on accidents occurring at night, as given by A. H. Vey in his article, "Relation of Highway Lighting to Highway Accidents" (*Transactions, Illuminating Engineering Society*, January 1935), testify to the value of highway lighting:

"In New Jersey last year (1933) there were recorded 33,803 accidents which caused 1,185 deaths and more than 28,000 personal injuries. Of these accidents, 44 per cent of the total and about 55 per cent of the deaths occurred on the highways at night or during such times when traffic was approximately 20 per cent of the 24-hour total. The National Safety Council in its pamphlet entitled 'Accident Facts,' states that in 1933, 58 per cent of all fatal motor-vehicle accidents occurred during dusk or darkness."

Considering that night traffic is much smaller in volume than day traffic, it thus appears that night accidents occur upon the highways from three to four times more frequently per motor vehicle than do day accidents.

That lighting of highways does reduce accidents at night is shown by a study made by Mr. Vey of accidents for the year 1933 on unlighted and lighted highways in New Jersey. The unlighted highway from Trenton to the Newark Airport, says Mr. Vey, had about one-half of the total accidents occurring during hours of darkness. The lighted highway from the Newark Airport to the Holland Tunnel entrance is a continuation of the unlighted stretch. When considering accidents of all types, it was found that there was an increase of 2.5 per cent of night accidents over day accidents along the unlighted stretch of the highway, while there was a decrease of 43 per cent along the lighted stretch.

Two principal practical forms of electric discharge lamps suitable for street and highway lighting are available—the high-pressure mercury-vapor lamp and the sodium-vapor lamp. The high-pressure mercury-vapor lamp emits a light which has a predominant blue-green color, with no wave lengths in the red bands of the spectrum. A degree of color correction can be achieved by incorporating cadmium, or cadmium and zinc, with the mercury. The efficiency is lowered, however, in proportion to the red content of the light. It is further possible to correct the color deficiency in the mercury-vapor light by combining with it the light from a tungsten-filament incandescent lamp, thus obtaining a whiter light than that furnished by present street lamps. An example of this is the installation of eight high-intensity mercury-vapor lamps in front of the post office at Lynn, Mass. Each unit consists of a mercury-vapor lamp and an incandescent lamp. The bluish-green of the mercury-vapor lamps and the yellow-red-white of the incandescent lamps blend into a white light said to be excellent for heavy-traffic thoroughfares.

Light from sodium-vapor lamps is monochromatic and is a golden yellow; consequently all objects, no matter what their true colors, appear as black or various shades of yellow. The use of sodium-vapor lamps seems especially applicable to rural highway lighting, where the effects produced by the monochromatic yellow light are no doubt of much less importance than on urban streets. The sodium-vapor type possibly offers the advantages of higher efficiency and greater economy.

Examples of the use of sodium-vapor lamps in highway lighting are shown in the photograph of an underpass at Sacramento, Calif., illuminated with two 10,000-lumen lamps, and in the view of Ballston Road, at Schenectady, N.Y., lighted by sodium-vapor lamps of 4,000 lumens each, staggered 125 ft apart. The recommended height for the lamp mounting is such that the distance from the road surface to the light center will be from 23 to 25 ft.

The most commonly used means of turning the lights on are automatic electric time switches and pilot-wire operation of control switches from remote points. The photo-electric control of highway lighting is one of the most logical ways to control the lights, and an increase in its use may be expected in the future. Proper highway lighting is costly, but when the benefits derived are considered, including the reduction secured in fatalities and accidents, it may be seen that it is desirable from the standpoint of safety and perhaps also from that of economy.

Some Features of the Mississippi Bridges

Foundation Conditions Vary Widely for Major Crossings Between St. Louis and the Gulf

By Harry J. Engel

Junior American Society of Civil Engineers
Assistant Engineer, Modjeski, Masters and Case, Inc., Philadelphia, Pa.

THE opening on December 16, 1935, of the new cantilever bridge across the Mississippi at New Orleans marked the completion of the eleventh major crossing between St. Louis and the Gulf. Four of these major bridges are situated in St. Louis, two are at Memphis, and the other four are at Cape Girardeau, Thebes, Cairo, and Vicksburg, respectively. The arched Eads Bridge at St. Louis, completed in 1874, was of course the first to be constructed. The remaining St. Louis structures are made up of simple spans and the Cape Girardeau Bridge uses continuous spans, but the other Mississippi crossings all employ the cantilever principle, with ingenious variations in some cases. This article, which supplements Mr. Engel's previous article, "Construction of the New Orleans Bridge," published in the December 1935 issue, illustrates the structural advances made in the past sixty years, as well as the progressive deterioration of foundation conditions and increasing demands of navigation encountered toward the Gulf.

THE Mississippi River rises in numerous lakes in the northern part of Minnesota and winds about 2,560 miles to the Gulf of Mexico, the exact distance varying from time to time with the meanderings of the waterway. Twelve hundred and seventy miles from its mouth, and six miles above the northern boundary of St. Louis, the Missouri joins the Mississippi, almost doubling its flow (Fig. 1). At Cairo, where the Ohio River enters, the volume of flow is nearly doubled again. In its upper sections the Mississippi is a cutting river; in the neighborhood of St. Louis it alternately scours and deposits material; and toward the mouth it builds land from sedimentary deposits. The resulting foundation conditions in many instances have influenced the type of bridge chosen, as well as the methods of construction employed.

On the Mississippi the upper limit of navigation occurs at the Washington Avenue Bridge in Minneapolis. Here the river has a low-water depth of 6 ft, the project depth of the navigable channel from Minneapolis to the northern boundary of St. Louis. At St. Louis the channel increases to 9 ft for a width of 300 ft, and continues with these dimensions as far as Baton Rouge, the upper limit of deep-water navigation. From there to the head of the passes through the delta, an existing project provides for a channel 35 ft deep at low water and 300 ft wide, to be maintained by dredging.

At each of these places the channel requirements are reflected in the over-water clearances required by the War Department in the bridges already built or projected. At St. Louis clearance requirements are determined by the Eads Bridge, which has 48 ft of vertical clearance over high water and a 520-ft width of opening. Below this point the clearances increase at Cape Girardeau, Thebes, Cairo, Memphis, and Vicksburg; and for a proposed structure at Baton Rouge, just above the limits of deep-water navigation, the War Department was willing to approve a vertical clearance of 65 ft and a width of 770 ft for the principal cantilever span. Finally, deep-water navigation at the site of the New Orleans Bridge necessitated a clear opening of 750 ft for the main span and a clearance of 135 ft above high water in its central part.

Fig. 1. Sites of Major Bridges Across the Mississippi Below St. Louis

The Story of the Eads Bridge

The Eads Bridge at St. Louis, shown in Fig. 2 (*a*), was the first of the major bridges to be constructed. It represents the first use of steel in a large bridge, and the first use of compressed-air caissons in the construction of large bridge piers in this country. The bridge stands today as an enduring monument to the ability of James B. Eads, M. Am. Soc. C.E.

Captain Eads was first identified with the project in 1867, as chief engineer of the St. Louis and Illinois Bridge Company, which planned to build a crossing for combined railroad and highway traffic. Drama was introduced at once by the activities of a rival bridge company under the leadership of a certain L. B. Boomer. Hoping to destroy public confidence in Captain Eads' plans (which called for three arch spans of about 500 ft each) and thus to make financing difficult, the Boomer Company called a convention of engineers at St. Louis to express by resolution "their unqualified disapprobation of spans of 500 ft" and to advocate instead the use of truss spans less than 350 ft in the clear. Captain Eads thereupon demonstrated very clearly that steel arch spans of over 500 ft were both feasible and economical.

His intention to carry the foundations to a depth of over 100 ft below water level in order to reach rock was also criticized. It was argued by his opponents that economy demanded very much shallower piers, embedded only deep enough to prevent scour from reaching their bases. But thirty years of experience with the Mississippi had convinced Cap-

ERECTION OF THE WEST AND CENTER ARCHES, EADS BRIDGE AT ST. LOUIS

tain Eads that the river bottom at St. Louis was unreliable. He had observed that a flood from the Missouri, when the Mississippi is low, leaves deposits of mud and bars which disappear in a joint flood, sometimes scouring in the presence of a temporary obstacle to a depth of 100 ft. He therefore insisted on rock foundations, and his good judgment was attested by the fact that pier excavations revealed the bedrock to be water-worn, showing that it had been exposed to river scour.

For sinking these deep foundations, Captain Eads decided upon the use of caissons with compressed air. Compressed air was first used in a shaft by Triger in 1841 to reach a vein of coal on a sandy island in the Loire River, France. In 1854, Brunel had used air at 40-lb pressure in constructing the center pier of the Royal Albert Bridge at Saltash, England; while in 1859, Fleur Saint Dennis had approached modern practice more closely in the foundations for the bridge over the Rhine at Kehl. Even at Kehl, however, the largest caisson was only 77 by 23 ft, and extended only 66 ft below high water. In proposing the pneumatic method for the much larger work at St. Louis, Captain Eads was forced to explain his reasoning in detail and to improve upon European practice.

In the actual construction of the Eads Bridge, the caisson for the east abutment was carried 110 ft below ordinary water level. This is so close to the practicable limit for men working under compressed air that there were 28 cases of bends and one death in spite of constant medical attention. The piers consist from the very base of almost solid stone masonry, largely limestone with some granite, so that the arch thrusts act directly upon stone resting on bedrock in the river.

Since the arches of the Eads Bridge were to have fixed ends, they involved a theoretical analysis unusual for the time. The chords of the arch trusses consist of chrome-steel tubes, built up of segments like staves of a barrel and bound around with metal sheeting. The contractors for the steelwork objected strenuously to Captain Eads' demands for careful workmanship and accurate testing, and much of our good modern practice in these matters must be attributed to the rigid standards set by Captain Eads at that time.

Erection of the arches was accomplished by constructing towers over the piers, from which suspension cables sustained the cantilevered ribs approximately at the third points, as shown in one of the photographs. When erection had proceeded to these third points, secondary masts were erected there to sustain a minor system of suspension cables for an extension of the cantilever erection. The elevations of the ribs were adjusted during erection by varying the cable tensions in this indeterminate system. In view of the absolute accuracy required, the contractors refused to accept the responsibility for inserting the closing members at the crown in the erection of the first arch span.

As Captain Eads was then in England with lung trouble, worn out by his engineering and financial battles, much of the responsibility fell upon his two assistants, Edward Flad and the late Theodore Cooper, Members Am. Soc. C.E. When the closing members proved to be too long for the gap left by summer tem-

GENERAL VIEW OF THE MCKINLEY BRIDGE AT ST. LOUIS

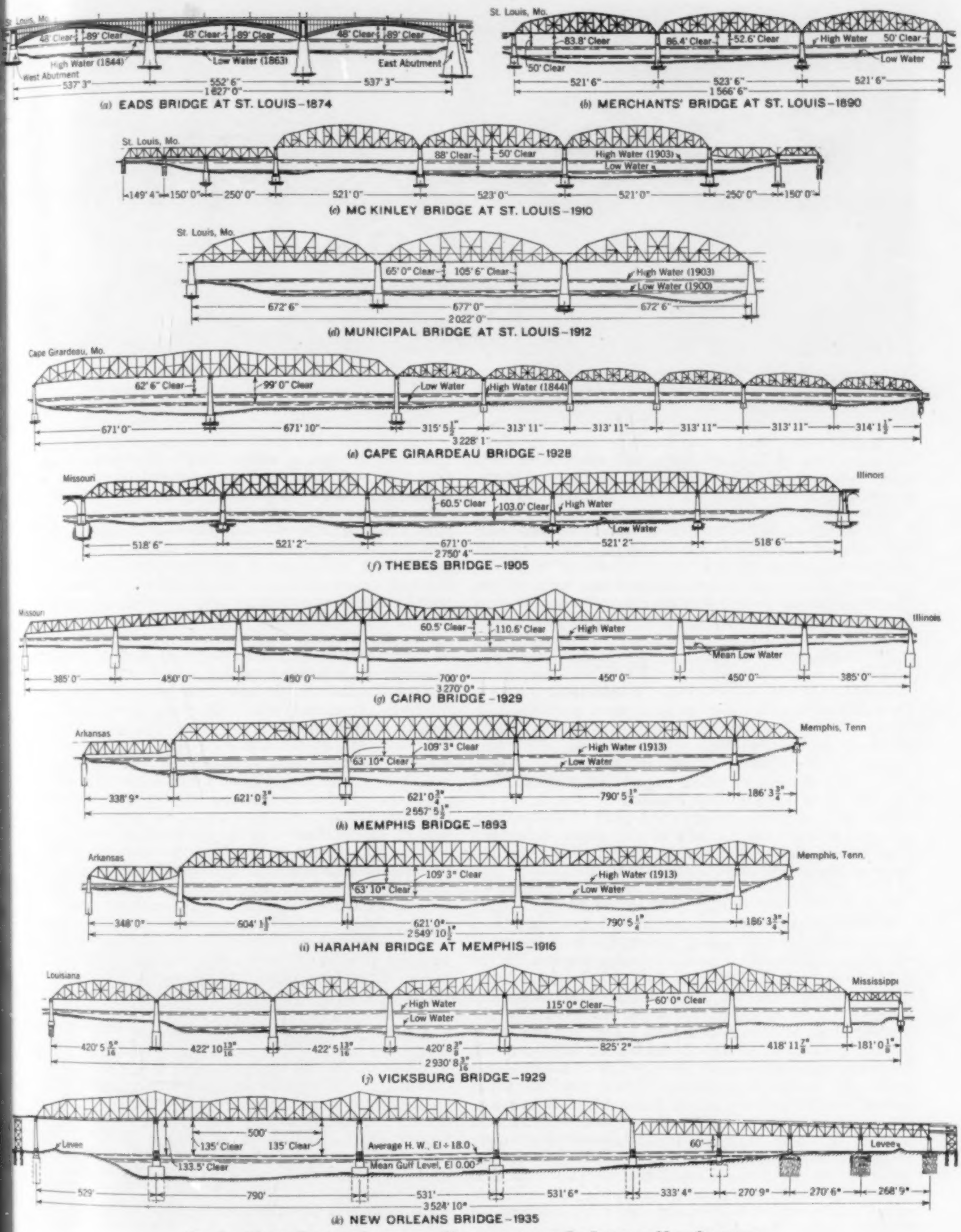
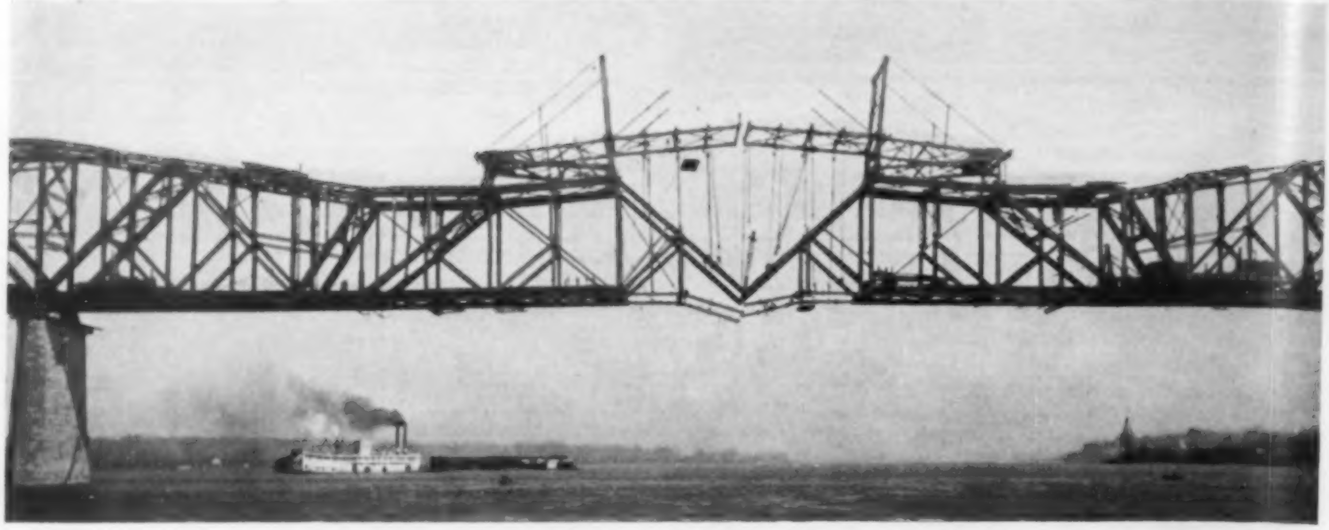


Fig. 2. Major Bridges Across the Mississippi from St. Louis to New Orleans
Elevations Shown Looking Upstream



CLOSING THE CANTILEVER OF THE THEBES BRIDGE, MARCH 31, 1905

peratures, Colonel Flad attempted to shorten the half arches by packing them in ice. This failed to produce the desired result, and it was found necessary to follow the suggestion of Captain Eads, and insert adjustable tubes with screw threads, which were later opened to the correct length.

Although most of the anxiety of financiers was overcome with the closing of the first arch and new loans were then effected to complete the bridge, Captain Eads encountered further difficulties. On January 16, 1874, after most of the arch steel on all spans had been erected, Theodore Cooper recorded in his diary the discovery of fractures at the couplings of two tubes in the bottom chords of the ribs of the west arch span. When Captain Eads received word of this he reviewed his calculations with anxiety to see if some factor had been neglected, but presently came to the conclusion that these fractures had resulted from a temporary excessive tension in the erection cables caused by falling temperature. This had produced an overstress at the couplings of the two bottom-chord members of the indeterminate system. He ordered the broken tubes stayed and replaced, and the damage was completely repaired by March.

The bridge was opened on July 4, 1874. Its total cost was $6,500,000. On account of the many difficulties encountered, this cost was very much higher than had been originally estimated.

LATER BRIDGES OVER THE LOWER RIVER

The other three bridges over the Mississippi at St. Louis are simple truss spans, founded on rock just as is the Eads structure. The next bridge constructed in point of time was the Merchants' Bridge, of which the late George S. Morison, M. Am. Soc. C.E., was chief engineer. This crossing, providing double-track railroad facilities, was opened in 1890. Mr. Morison was a pioneer in the construction of important bridges over the Missouri, Mississippi, and Ohio rivers, and has to his credit the earlier Memphis Bridge over the Mississippi as well as this crossing at St. Louis. The Merchants' Bridge set the precedent for the type of construction used in the later St. Louis bridges, employing simple through-truss spans of 503-ft horizontal clearance instead of the more complicated though more beautiful arches of the earlier structure [Fig. 2 (*b*)]. These simple spans also provide clear passage over a greater width for river traffic, thus satisfying the navigation interests, which did not discover to what an extent arch spans would restrict shipping until the Eads Bridge was actually under construction.

Just downstream from the Merchants' Bridge is the McKinley Bridge, of which Ralph Modjeski, M. Am. Soc. C.E., was chief engineer. Opened in 1910, it provides both railroad and highway facilities. This structure, which consists of three main simple spans [Fig. 2 (*c*)], each with a 500-ft horizontal clearance, is an example of changing practice in the design of piers. The foundations are carried to solid rock but the pier footings are of concrete, and the shafts of concrete faced with limestone, as compared with the solid stone masonry piers of the Eads Bridge.

The Municipal Bridge at St. Louis [Fig. 2 (*d*)], completed in 1912, is used by highway traffic only. Its substructure is founded on rock.

Rock foundations at Cape Girardeau, 130 miles below St. Louis, were used to advantage by John L. Harrington, E. E. Howard, and the late L. R. Ash, Members Am. Soc. C.E., in designing two 671-ft continuous spans for the highway bridge completed in 1928 at this point [Fig. 2 (*e*)]. Rock was found 70 ft below low water.

For the Thebes Bridge, which was opened in 1905, rock foundations were also available. A cantilever design with a 671-ft main span was used here for simplicity [Fig. 2 (*f*)]. It is interesting to note that the principal span was completed without falsework by erecting the halves of the suspended span as extensions of the cantilever arms and joining them at the center. One of the photographs shows this operation in progress. Special adjusting wedges were used in the top and bottom chords at the end of each cantilever arm, and when the two halves of the span were about to be joined in the center, the wedges were gradually withdrawn until the proper connection was made. Frederick C. Noble, M. Am. Soc. C.E., and Mr. Modjeski were chief engineers for the Thebes crossing, which is a double-track railroad bridge. The deepest pier reaches rock at 88 ft below low water. The main pier footings are of concrete, and the pier shafts are faced with limestone and granite.

On the Mississippi, the southernmost limit for rock foundations seems to occur at Thebes. For this reason the cantilever type of long-span construction prevails in the remaining bridges to the Gulf, at Cairo, Memphis, and Vicksburg, as well as in the projected structure at Baton Rouge and in the crossing at New Orleans. The cantilever principle is employed with ingenious variations in the Thebes, the Cairo, and the two Memphis bridges.

Where several fairly long spans are required over a considerable width of river, it is of course possible to place several cantilever bridges end to end. In this case it is sometimes economical to employ a common anchor arm for two flanking suspended spans. Several possible combinations employing this idea are illustrated in Fig. 2. Thus, the Cairo Bridge is in effect three cantilever bridges merged into one by the use of two common anchor spans; the Thebes crossing also employs two spans for this common purpose but has a different end treatment; and the two Memphis bridges each employ only one long span intended to support flanking suspended spans.

The Cairo Bridge [Fig. 2 (*g*)], a highway structure, was completed in 1929 with J. A. L. Waddell and Shortridge Hardesty, Members Am. Soc. C.E., as engineers. The piers were carried 90 ft below low-water level and founded in very coarse sand, although a layer of hard clay occurs some distance above.

The Harahan Bridge at Memphis

At Memphis, a layer of hard blue clay at a maximum depth of 96 ft below low water was the foundation material used by Mr. Morison, chief engineer on the construction of the first railroad crossing opened there, in 1893 [Fig. 2 (*h*)]. Borings made at the site of the later Harahan Bridge, just 200 ft upstream from and parallel to the earlier structure, disclosed no bedrock even though borings were carried to a depth of 200 ft below low-water level. Mr. Modjeski, chief engineer for the new bridge (opened in 1916) therefore decided upon the use of the same stratum of hard blue clay for the foundations. Pneumatic caissons were used. The deepest pier is founded at a depth of 94 ft below low water. Pier footings are of concrete and shafts are faced with granite. The Harahan Bridge has a principal cantilever span of 790 ft [Fig. 2 (*i*)], with double railroad tracks in the center and highway lanes outside the main trusses.

Continuing south from Memphis, foundations become progressively more difficult. In the combined railroad and highway bridge at Vicksburg [Fig. 2 (*j*)], completed in 1929 with Harrington, Howard, and Ash as engineers, the piers were carried by means of compressed-air caissons to a depth of 110 ft below low water, where they were founded in sand. Here, as well as at the site of the proposed Baton Rouge Bridge and at the New Orleans crossing, the foundations are in ground built up by the river. Under such circumstances the cantilever type of structure is obviously advantageous, since it permits minor settlement of the supports without affecting the stresses in any of the members.

Portal View of the New Orleans Bridge

THE NEW ORLEANS BRIDGE

Although a crossing at New Orleans had been considered for a long time, it was not undertaken until recently, in part because of the hazards of construction and the clearances required at the site, which combined to make it a costly project. The final choice of a high-level bridge with 135-ft vertical clearance over high water [Fig. 2(*k*)] was reached only after studies had been made of tunnels, low-level bridges, and various high-level structures similar in type to the present one.

This bridge consists of a 790-ft main cantilever span and two 528-ft anchor arms, with added simple spans over the river and steel trestle approaches. It provides facilities for two railroad tracks in the center, with two 18-ft roadways and sidewalks cantilevered outside the main trusses. Since high water on the river is well above ordinary ground level at New Orleans, the required clearance combined with the slight railroad grade has made the structure almost $4^1/_2$ miles in total length.

The river piers, which extend 170 ft below Gulf level, were founded in good sand by means of open-dredged caissons with sand-island protection. The suspended span of the cantilever was erected by proceeding outward from the cantilever arms to closure at the center of the main span. The cost of the finished bridge was about $13,000,000, and Modjeski, Masters and Case, Inc., were the engineers.

It is significant that modern engineering planning and the accumulated experience of the last half century have lessened the drama so common in the earlier days of bridge building, permitting projects of considerable hazard to be completed according to a definite schedule and within an accurately predetermined cost.

Treatment and Recovery of Sulfite Waste

A Survey of Ways to Alleviate Stream Pollution and Possibilities for Profitable Use of the Liquor

By F. Merryfield

Associate Member American Society of Civil Engineers
Assistant Professor of Civil Engineering, Oregon State College, Corvallis, Ore.

Effective means for the disposal of sulfite wastes is much desired today by sanitary engineers who seek alleviation of stream pollution. Tests indicate that ponding and aeration will give some relief by effecting a material reduction in biochemical oxygen demand. An effective method for profitable recovery of sulfite liquor would be very welcome to the pulp and paper industry, which witnesses a daily loss from blow tanks, screens, and washers of 2,000 gal of sulfite liquor per ton of pulp produced. Many patents have been issued for processes for the recovery and utilization of the liquor, but none has proved economically attractive to the industry as yet. This article, abstracted from Professor Merryfield's address before the Northwest Stream Pollution Conference at Lewiston, Idaho, on May 15, 1935, is the result of a study of the past ten years' literature on this subject.

The problem of disposal of industrial wastes has been solved in many instances by the production of a by-product which has brought a profit to the industry. It is possible that the wastes from sulfite pulp mills may eventually be treated in such a manner that they also will be an asset rather than a liability. All true conservationists hold this view but realize that more study is required before an economical use of many waste products can be developed. With the production of many tons of sulfite pulp per year and the corresponding production of wastes, it is necessary that the market for the treated waste be large.

Alleviation of stream pollution can never be, in the long run, as economical as the use of the wastes themselves. Moreover, it is not a reasonable policy to dismiss the problem until a full solution of it has been guaranteed.

Sulfite pulp and paper is made by chemically digesting, under pressure and at a high temperature, clean chips of hemlock, spruce, and white fir woods. As shown in the graphic flow chart, Fig. 1, the chips are fed into a large, brick-lined, pressure digester along with a solution of sulfurous acid and calcium acid sulfite. Steam is used inside the digester to provide heat and pressure. The chemicals dissolve the lignins, polysaccharids, and resins from the cellulose surrounding the fibers and leave the latter practically untouched. At the end of the digestion period, the liquor and fibers are driven out from the digester into the blow pits, which are equipped with perforated false bottoms to drain the liquor from the fibers. The drained-off liquor is known as waste sulfite liquor. The fibers are then washed for a period of a half-hour or so, to displace the sulfite liquor still surrounding them. In many mills this washing is done with the white-water wastes drawn from other parts of the mill. The sulfite liquor proper, however, is never reused but finds its way to the sewer outlet and into the river. Some 48 per cent of the wood used in this process is dissolved out during digestion and appears as waste in the liquor. The total solids content of the sulfite waste varies from 84,000 to 130,000 ppm, depending upon the particular digestion period and the mill.

In one test in which the total solids content was 116,900 ppm, the suspended solids were 81 ppm and the dissolved solids, 116,800. In this same sample 104,900 ppm was combustible matter and 12,000 ppm, non-combustible.

The 20-day biochemical oxygen demand (B.O.D.) varies from 16,000 ppm to around 25,000 ppm (Fig. 2). The differences in B.O.D. that exist between sulfite liquors may be due to the fact that it is almost impossible to obtain this liquor undiluted with some wash water, since mills do not make a practice of blowing their liquor and fibers into dry blow pits. The initial oxygen demand of the sulfite liquor is much higher than that of sewage (Fig. 3), in all probability because of the rapid oxidation of loosely combined substances and dissolved gases. The amount of liquor discharged per ton of pulp produced varies from 1,600 to 2,500 gal; a fair figure for rough estimates would be 2,000 gal per ton. The amount of material that must be oxidized is approximately one ton per ton of pulp produced.

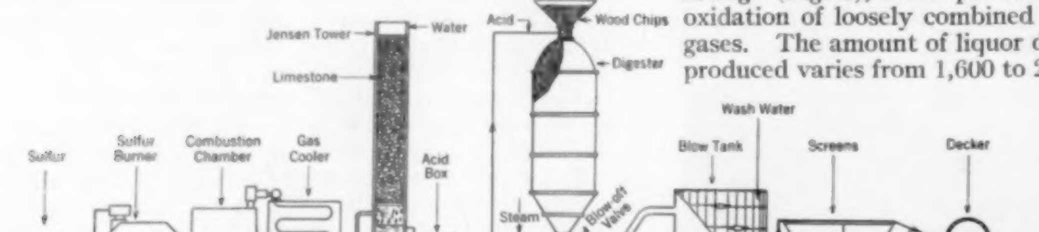


Fig. 1. Sulfite Process for Wood-Pulp Paper
Graphic Flow Chart Prepared at Engineering Experiment Station, Oregon State College

While the B.O.D. is not necessarily the true indication of what actually occurs in the stream, it serves as a reasonable measure of the relative strength of this waste with respect to other wastes. There is every reason to believe that the oxygen demand of the liquor

in the stream is actually greater than the B.O.D. indicates. The determination of the B.O.D., however, will make possible approximate minimum estimates of the quantity of oxygen used up in the stream.

The industry itself is fully cognizant of the problem, since every day each plant records through its chemist this great quantity of lost material. With the probable future expansion of the sulfite pulp industry in the Northwest because of the availability and cheapness of the raw material, the problem of what to do with the waste from the point of view both of pollution and of recovery should be of paramount importance to the sanitary engineer in this region.

Ponding and Aeration Reduce Stream Pollution

Alleviation of stream pollution is of most immediate importance to the sanitary engineer. At the present time there is no known process for the treatment of sulfite waste which will produce an effluent comparable to that from domestic sewage in modern plants. In the treatment of large quantities of wastes, high in dissolved matter (about 100,000 ppm), it is obvious that the application of large quantities of chemicals would be required to secure precipitation. In some way oxygen must be supplied to the waste before it enters the stream.

Ponding and aeration, then, are indicated as the way to secure immediate relief. Extensive tests have been carried out in Wisconsin (Special Report, Department of Sanitary Engineering, University of Wisconsin, January 1927) on ponding, spraying, and cascading sulfite waste liquor. The following excerpts are from this report:

"1. Ponding and aeration of the waste [sulfite liquor] will effect a very material reduction in its oxygen demand, preliminary tests indicating 76 to 92 per cent reductions in $^1/_2$- to 5-day demands. These reductions are believed to be higher than will be obtained with continued treatment.

"2. Mechanical aeration, such as provided by the Bassley-spray device, will also reduce the oxygen demand of sulfite waste liquor, tests indicating from 34 to 60 per cent for 1- to 5-day demands.

"3. The initial oxygen demand is probably due in large part, if not entirely, to direct rather than biological oxidation of the most unstable constituents of the wastes, such as free or loosely combined sulfur dioxide.

"4. Ponding, particularly where large storage capacity is possible, avoids intense periodic stream pollution by the waste, and provides an opportunity for partial satisfaction of the oxygen demand. Where sufficient land is available, the cost is nominal.

"5. The ultimate solution of the sulfite waste liquor

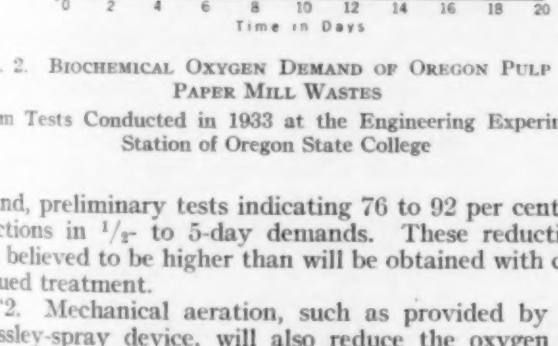


Fig. 2. Biochemical Oxygen Demand of Oregon Pulp and Paper Mill Wastes

From Tests Conducted in 1933 at the Engineering Experiment Station of Oregon State College

Sulfite in Liquor Discharged from an Oregon Pulp Mill Into Willamette River

problem lies in utilization as a fuel or in the manufacture of valuable by-products rather than in treatment."

Recommendations are also offered in the report. The following are of general interest:

"1. Ponding of the sulfite waste liquor should be practiced where feasible, prior to discharge into streams.

"2. Cooperative research should be conducted by the pulp and paper industry to develop better methods of washing the sulfite pulp, thus preventing excessive dilution of the spent liquor from the digesters, as an initial step in providing recovery systems for economical utilization of the waste liquor."

In a later report from the same source (1931), ponding and aeration were suggested as a means of reducing the oxygen demand.

Laboratory tests conducted by M. J. O'Dell and A. Z. Greenlaw, Jun. Am. Soc. C.E., at the engineering experiment station of Oregon State College led them to draw the following conclusions (*Paper Trade Journal* for August 23, 1934):

"Under properly controlled conditions, ponding and aeration will greatly reduce the biochemical oxygen demand of sulfite liquor. Such a reduction would accordingly diminish the demand of this waste for the oxygen in the stream, and thereby eliminate part of its pollutional effect.

"Aeration is a simple treatment for sulfite liquor wastes, and is considered to be economically feasible. Although ponding is not an ultimate solution to the sulfite mill waste problem, it might be used temporarily during periods of low water when the river is unable to carry the pollutional load of the sulfite liquor."

Ozonization was suggested in the *Pacific Pulp and Paper Industry* for December 1931, as a method of rapid oxidation. Cost data from experimental work have been worked out, but it has been generally conceded that the production of ozone under present methods is uneconomical for full-sized plants.

Uses for Recovered Sulfite Liquor

The pulp and paper industry, and those closely connected with it, have studied this problem of treatment for many years. To date more than 1,500 patents have been issued for the recovery and utilization of the waste liquor. This indicates not only general recognition of the tremendous daily loss, and energetic effort on the part of the industry and its chemists to seek a solution, but also the peculiar difficulty of the problem from an economic point of view.

It is not to be understood, however, that there is no

solution. In the light of modern technic, treatment processes probably can be developed, but all will require the outlay of large sums of money before results can be obtained. Should a process be perfected whereby a profit could be made, the industry would undoubtedly use it, and the problem of pollution would disappear. The review of the uses of sulfite liquor prepared by W. E. B. Baker and G. K. Spence for the Sanitary Water Board of Pennsylvania and submitted in June 1932 is pertinent and is abstracted in the following paragraphs:

1. *Binding Materials.* The liquor in concentrated form has been used as a binder in coal or briquettes and in the building of roads. The binding strength is low, however, and wherever the dark color of the liquor is detrimental, it cannot be used. This outlet could only absorb a relatively small fraction of the liquor available.

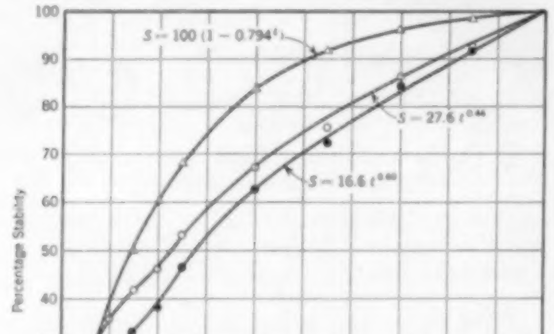


FIG. 3. STABILITY OF SULFITE LIQUOR AND DOMESTIC SEWAGE
From Tests Conducted in 1933–1934 by the Engineering Experiment Station of Oregon State College

2. *Gums, Adhesive, and Sizing Materials.* The bonding strength of the liquor can be increased by concentrating and modifying it, but the great objection of color remains. Furthermore, the adhesive strength is less than that of starches and dextrins.

3. *Tanning Materials.* The liquor has been used in tanneries for drumming in excess tanning material. However it cannot be used as a primary agent as it gives an undesirable color to the leather. Again, only a very small part of the available liquor could be so used, even if it were applicable to every type of leather manufacture.

4. *Alcohol and Yeast.* Of the 22 plants in Scandinavia that produced grain alcohol from sulfite liquor during the War, only two now produce it. The war time activity was caused by the high cost of gasoline. The two plants still in operation are manufacturing alcohol as a beverage. Some of the plants turned to the manufacture of yeast, by a modification of the procedure.

5. *Fodder.* There seems to be a possibility for the utilization of the liquor in the production of fodder for cattle. A distinction, however, must be made between what is possible and what is practicable. Cattle consume great quantities of foodstuffs per unit weight, and man consumes a considerable poundage of cattle per annum. If satisfactory procedures were developed for using the liquor as cattle food, a large amount could be consumed.

6. *Fertilizers.* Agriculture is probably the only industry large enough to absorb all the liquor produced. The return of the material (lignin bodies) to the soil, their point of origin, is logical providing it can be done economically. In its present form it doubtless would not prove nearly as effective as, for example, if it were reconverted into lignin in gel form, which has been proved possible, so that it would have the property of holding the rainfall much more effectively than does the ordinary soil. At the same time the slow reactions that take place when wood decays in the presence of soil could go on in a manner substantially analogous to that in progress in woodland areas where decayed foliage and debris help to provide eventually a rich tillable soil.

It is true that many angles of this question are worthy of investigation, and it is likewise true that nothing has been developed thus far which would justify or make economically sound the construction of a sulfite-liquor by-product plant to turn out fertilizer or fodder. The reason appears to be that no single manufacturer is sufficiently large to cope with the problems involved. There are basic problems which may well merit the attention of those departments of our government which have the facilities, personnel, and influence to undertake a solution. The national government and the state governments have departments of agriculture and forestry which are the logical organizations to attack this problem in such a manner that the greatest good for the greatest number can be realized.

MAKING SULFITE LIQUOR AVAILABLE AS FUEL

Before sulfite liquor can be used successfully as a fuel, it must be concentrated to reduce its bulk. The solution of this problem, involving economic heat balance in the evaporation of the liquor, has been hastened by the production of stainless steel and by the development of high-velocity evaporators, which offset severe corrosion and formation of scale in the evaporators. In order to obtain the required capacity, it is necessary to use expensive, rapid-circulation evaporators with great differences in temperature between the material evaporated and the heating agent. In order to secure the necessary high pressure, steam must be used. The exhaust steam from the evaporators, and the steam evaporated from the liquor can be used in the digesters. While sufficient steam can be generated in this way, the concentrated liquor might not have wide use as fuel for the generation of power and steam in the Northwest, where hog-fuel and waste wood are cheap.

It is known that one mill in Washington is concentrating its liquor by the spray process. Also, the Robson process of pressure evaporation and combustion is used by the West Virginia Pulp and Paper Company. Details as to efficiency and costs are lacking.

The installed cost of equipment ranges from $700 to $1,500 per ton of plant capacity. The variety of patents issued for the purpose of making sulfite liquor into fuel as yet have not made the industry particularly anxious to use them. However these processes are undoubtedly possible and in certain instances may be economical.

To summarize, it is evident that the problem of disposal of sulfite liquor looms large in the industry and among sanitary engineers. The best opportunities for such disposal seem to be utilization as cattle fodder, fertilizer, and fuel, considering the need for economy and the large quantities of liquor produced.

Plant-size tests on ponding and aeration are necessary before any generalization can be made as to the efficiency of these methods in reducing the oxygen demand. Ponding has the additional advantage of regulating the flow of liquor into the receiving stream, thus preventing the evils of batch disposal, the method generally practiced at the present time.

Engineering and Architecture

Should Not These Two Ancient Professions Speak the Same Language?

By J. K. Finch

Member American Society of Civil Engineers
Renwick Professor of Civil Engineering, Columbia University, New York, N.Y.

The engineer-architect of earlier times, under the comprehensive title of master builder, erected the great temples of Egypt and of Greece; built the monumental Roman aqueducts, of which the Pont du Gard is an eloquent reminder; produced the unique fortress-home of medieval times; and developed the daring skeleton-stone construction and the lofty vaulting of those masterpieces of earlier construction, the Gothic cathedrals. During the Renaissance, however, engineering and architecture began to draw apart, and during the last hundred years have followed divergent techniques to such an extent that in methods, viewpoints, and ideals they no longer speak the same language. After an interesting historical summary, Professor Finch prescribes for architects a study of modern materials and construction methods, and for engineers, greater attention to esthetic elements in design. The article is abstracted from an address given before the Junior Branch of the Metropolitan Section on November 26, 1935.

Today the civil engineer generally regards his relationships with the other branches of engineering—mechanical, mining, metallurgical, chemical, and electrical—as far closer than any possible liaison which may exist between his profession and that of the architect. As the members of these other divisions of engineering speak the same language, a meeting of minds is easily secured. On the other hand, the architect is supposed to rave about form and color and to exhibit those peculiar habits of mind, speech, and dress that are said to mark the artistic temperament. But as a matter of fact, there are many reasons why civil engineering should be more closely related to architecture than to any of the other branches of engineering.

The truth of this statement can easily be demonstrated. The civil engineer and the architect, even today, occupy the same field—they are both structural designers and members of the construction industry. This industry differs greatly from those related to the other engineering groups in that it secures the materials of construction from the so-called material engineers—mining, metallurgical, and chemical—and utilizes not only man power, but also the products of power engineering, that is, mechanical and electrical power and appliances. The industries represented by material and power engineering, in producing consumers' goods, share the peculiar problems of design for mass production and of distribution and marketing which are a characteristic of production industries. On the contrary, the construction industry is a business of capital goods, having very different characteristics and problems. Many of these are common to the civil engineer and architect, but not to the other engineering branches.

From the standpoint of history, we would again expect to find the civil engineer and the architect close friends rather than to find them, as we frequently do, at loggerheads. Architecture and what we now call civil engineering are among the oldest professions, whereas the branches of engineering other than civil are of comparatively recent origin. Two of them—chemical and electrical engineering—are hardly fifty years old and are developments not of the engineering field, but of scientific discovery. Civil engineering and architecture have a record of over fifty centuries of service to mankind. And, most surprising of all, for over forty-five of these fifty centuries they were a single profession. They thus possess one of the strongest of all ties, that of a common ancestry. This cannot be said of the relationship between civil and most of the other divisions of engineering.

When the architect complains of the civil engineer as the originator of so much of the ugliness of the modern world, and when the engineer counters with the charge that the architect is a soft-headed dreamer who spends money for beauty which is only skin deep, we should recognize that a family scrap is on. But family bickering may often be bitter, and the question may well be asked: "What has caused this mutual lack of respect? Why should two professions which are the principal members of the same industry and have a more or less common history, fail to agree?"

The answer may be given in one word—technique. A common technique has held all engineers together in one family. Since the architects did not adopt it too, they remained outside, and civil engineering and architecture drew apart. While this new technique was being developed in the engineering field, what many engineers—and architects as well—believe is a narrow and unprogressive veiwpoint developed in architecture. This helped to widen the gap. Thus two professions, sisters under the skin, have developed with diametrically opposed methods, viewpoints, and ideals.

The Master Builders of Egypt

Let us consider for a moment the methods and viewpoints of the two professions during that long period when they were one. In doing this, it will be necessary to review briefly the early history of civil engineering from its birth in the fertile valleys of the Nile in Egypt and its development in the Tigris-Euphrates Valley in what the British forces in the Great War called Mespot.

The Earliest Known Engineering Title Signified "Master Builder"

One of the accompanying illustrations shows what is probably the earliest title for the civil engineer–architect of those early days. The open mouth signified "he who speaks"; the owl perhaps even in those days symbolized knowledge, or authority; while the stilt-like character, probably a scaffolding support, meant "construction"—thus, "he who speaks with authority on the work of construction," or the master builder.

In Fig. 1 is given in outline what I have called the engineering family tree, although there are several almost completely separate lines of descent. The engineering–architectural relationship, however, is clear. It

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EARLY DORIC COLUMNS, ABOUT 540 B.C.

Ruins of the Temple of Apollo at Corinth. Note Ponderous Caps and Heavy Proportions

follows down without a break from at least 3,000 B.C., the ancient period of which we have been speaking, to about 1,500 A.D. When Greece carried the torch of civilization the master builder became the *architekton*, or arch-technician, high priest of the technical workers. This is evidently only another form of the master-builder designation. It included civil or military engineering (the only branches then existent) and also what we now know as architecture. When leadership passed to Rome, the name of the master builder became *architectus*.

Finally, after Western civilization had been almost snuffed out by invading barbarian hordes from the north, after centuries of struggle during which our barbarian ancestors gradually settled down and began to discover their heritage from classical times, there came the Renaissance. During this latter period, the growth of a thousand years blossomed into remarkable achievement. But with it there came also gunpowder, an invention which, with cannon and stone cannon balls, was destined to blow the ranks of the master builders wide apart.

For now the military engineer was in great demand, on account of the constant bickerings and struggles of the ruling classes, from king to petty noble and bandit chief. The military engineer began to study the technique of casting cannon, and the problems of powder, shot, and trajectory, which were little related to his ancient occupations. The earthwork fort was a development of this period, and was non-architectural. In the course of a century the military expert, becoming completely detached from the ranks of the master builders, acquired a name of his own from the medieval Latin term *ingeniator*, which was used as early as the twelfth century in referring to the ingenious individual who constructed the portcullis, the drawbridge, and similar devices which formed a part of every well-equipped fortress-home. The military *ingeniator* later became the military engineer. On the other hand, the construction expert, continuing to design buildings, palaces, and churches, was still referred to by the old Greek title of arch-technician, which was shortened to architect.

EARLY CIVIL ENGINEERS HAD NO SCIENTIFIC TRAINING

For some time, the man we now know as the civil engineer was more or less out of the picture. There was little public life, and professional practice was confined to meeting the military and building needs of the nobles. In some localities members of the monastic orders built a few bridges. When the demand finally did come for civil works, it was met not only by the new architects and (more frequently) by the new military engineers, but also by men of no previous training but of great inherent ability drawn from all ranks of private and public life.

Nevertheless, many of the great French engineers of the seventeenth and eighteenth centuries continued to be members of the Academy of Architects as well as of the Corps des Ponts et Chaussées. But about 1750, John Smeaton, the British builder of the Eddystone lighthouse, dubbed himself civil engineer, and the last link in title between the architect and the engineer was severed.

Summarizing these relationships, it is seen that the family tie between architect and engineer is a long one. Indeed many believe that the differences between the two cannot be very deep or fundamental. Not only as

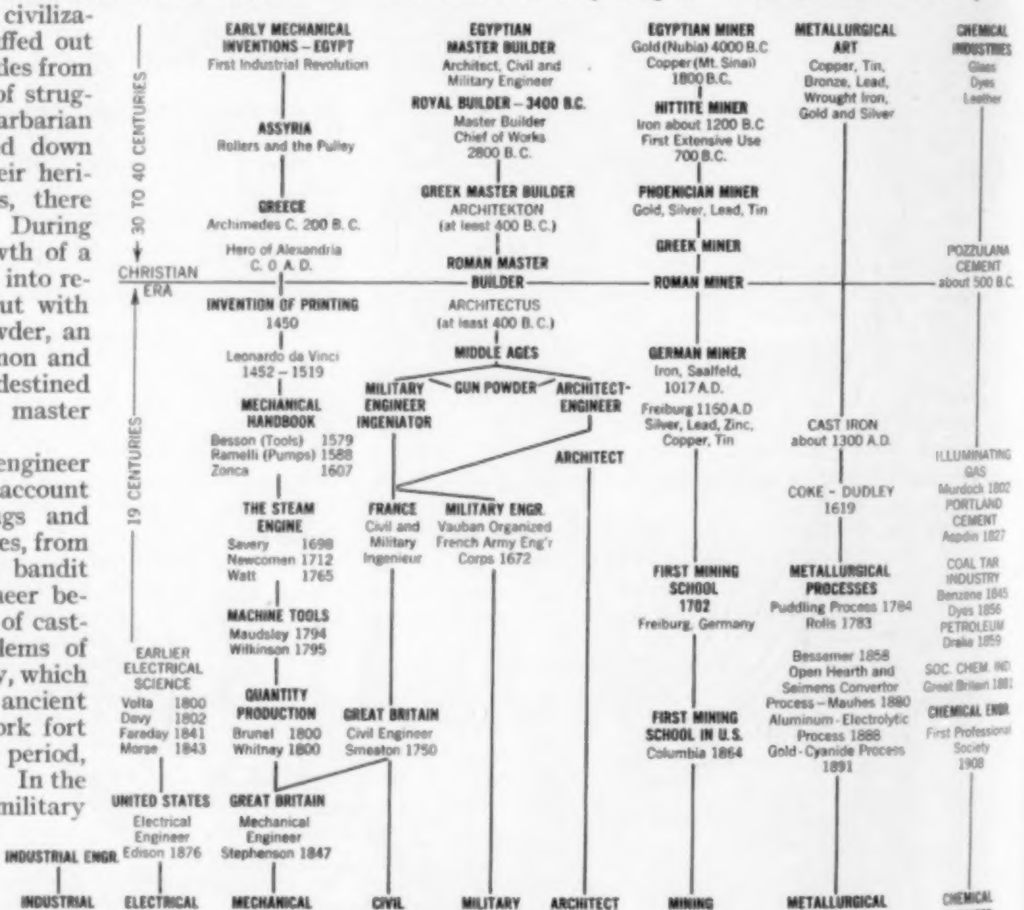

FIG. 1. THE ENGINEERING FAMILY TREE

late as the Renaissance but even up to the middle of the last century, the basic technique of the two professions was identical. They have thus used the same technique for something like 98 per cent of their recorded careers.

What was this common technique, it may now be asked, which bound the two professions together in times past, and what changes took place to lead them so far apart? A few high spots in the practice and development of this technique may be illuminating.

In early days there was, of course, no rational mathematical technique of design such as that which engineering has developed during the past century. Structural design was based on actual experience with structures, and on an inherent structural sense.

BUILDING THE GREEK TEMPLES AND ROMAN AQUEDUCTS

Consider the Greek temple. The basic structural elements involved here are, as in Egypt, the column and the lintel. Through practice, feeling for form, experience, and intuition, more or less standard proportions were developed for columns. The early Doric columns were dignified but ponderous. Note the evolution of the Ionic type, moving towards slenderness and grace, as experience and knowledge gave the builders increased confidence. Greek columns were made about 8 to 12 diameters high. Since the ratio $\frac{l}{d}$, which divides the pure compression pier from the bending-compression column of today, is in this same range, it seems evident that experience and intuition can arrive at rather close approximations. The Greek master builders, who even reinforced some of their beams with wrought-iron bars, clearly had some knowledge of the strength of materials as well as a keen structural sense developed beyond the purely qualitative stage. Thus the Doric column was followed by the Ionic, and later by the still more slender and graceful Corinthian. Intimate contact with materials and a remarkable structural judgment made possible the growth of a perfect art in stone.

Now let us pass on a few hundred years to Roman times. A photograph shows the famous Pont du Gard, which carried the covered canal section of the Nismes aqueduct at grade over a valley of Southern France. Its heavy, massive lower arches are of 51 to 74-ft span. In my opinion this bridge, in its simple dignity and massiveness, reflects more impressively the power and the achievement of Roman civilization than any other Roman work. And we must remember that all this was done without graphic statics, testing machines, or slide rules.

THE CATHEDRAL BUILDERS OF MEDIEVAL TIMES

Now let us pass over about a thousand years and look at the work of the cathedral builders. Let us consider only the cathedral nave (Fig. 2)—a long hall with side aisles formed by filling in with glass the spaces between a series of stone "bents." Note the plan of one of these bents. The elevation is shown in Fig. 3. Here the thrust of the main arch is carried by the flying buttress to the outer buttress, which in turn carries it safely to the ground. The characteristic flying buttress is a structural member. Even the finial on the buttress has its structural function; it gives added weight to the buttress to turn downward the thrust of the arch.

If we should trace the history of this bird cage in stone back through earlier ages, we would find the idea of the clerestory lighting of the Gothic cathedral expressed in ancient Egyptian temples. We would follow the growth of vaulting and the development, in the Romanesque period, of the Roman basilica type of structure, which was revived as a suitable form for the early Christian Church. And finally we would arrive at the culmination of perhaps a thousand years of study and experience in this remarkable skeleton-stone construction of the Gothic builder.

Henry Adams, in his book tracing the development of medieval and Gothic architecture from Mont St. Michel to Chartres, compares the cathedral spire to the spirit

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IONIC COLUMNS OF ERECHTHEUM, ATHENS

Showing the Development in Slenderness and Grace with Increasing Knowledge of Material and of Structural Form

of man stretching his arms up to the heavens. He tells in wonderful prose of that age in which mankind sought peace, aid, and support in an appeal to the Virgin, in the glorification of woman. However, he neglects the fact that these beautiful works of man embody structural accomplishment as well as spiritual beauty.

Similarly, we may follow the evolution of the stone-arch bridge through Roman and Renaissance times to its perfect solution in Perronet's Pont de la Concorde. Faced with this problem today, the engineer of the twentieth century, with all his mathematical technique, could not have improved this masterpiece of 1791. It was designed by a man who knew the fundamentals of arch design and had a "feeling" for structure, but who designed by looks rather than by mathematics. Even today, with all our modern knowledge, we recognize many of these earlier works as the perfect achievements of the structural genius of a bygone day.

DIFFERENT TECHNIQUES DEVELOP

About a century ago, however, a far-reaching change in the technique of engineering design took place. In this

THE PONT DU GARD, PART OF AN ANCIENT ROMAN AQUEDUCT
This Massive Work Was Constructed in Southern France About the Beginning of the Christian Era

movement the French were pioneers, the British added a very practical viewpoint, and the pressure of economic competition did the rest. Engineering and architecture began to draw further and further apart, for the architect did not follow the engineer in this new development.

By the time of our Civil War, some 75 years ago, the engineer was testing materials—timber, stone, wrought- and cast-iron. He was able to analyze the stresses set up in the various parts of structures under the assumed load, and to proportion these parts by using safe working stresses based on the results of the material tests. Design, previously an art, was on its way to becoming largely a science. Scientific technique in design led to safety, economy, and standardization. We began to build both bigger and better bridges, and were able to train men who possessed little structural judgment, compared with the leaders of the earlier era, to do most of the engineering bookkeeping, that is, the detailed calculations required in this scientific, standardized process of design.

This process continues today. Every year a new scientific approach is developed for some step in the process of engineering design which has hitherto been a matter of structural judgment. The result is that the engineer today first analyzes the service, loading, and requirements of a structure, and then proceeds to develop the most economical structure to meet these needs. There is little "free will" in modern engineering design, which is looked upon as the inevitable result of a logical and scientific process over which the engineer exercises little control. To the engineer, the external shape or form of a structure is the product of a perfected process of creation which operates under economic and physical laws, whether it is esthetically pleasing or otherwise.

ARCHITECTURE CONTINUES DESIGN BY LOOKS

Where does the architect stand? In the first place, he did not follow the engineer in the development of this new scientific technique of design. He was conservative, and continued to design by "looks." He was an artist, not an economist working through applied science.

In the course of time he lost first-hand contact with structural evolution. He saw timber and stone replaced by steel and concrete, but was only an observer of the development of new standards for these new materials. He saw the arch replaced by the truss, but offered no suggestions as to how the truss could be refined in form and grace. He became a victim of the artistic temperament and began to see in the creation of beautiful forms the sole end and object of architecture. Perhaps this reflected a defense attitude on the part of the architect, and a desire to set himself as far away from ugly, commercialized, utilitarian engineering as possible. A noted professor of architecture wrote in 1914: "We must think of true architecture, not as the development of economical planning, not as the expression of construction, not as adherence to historic or contemporary precedent, but as the fundamental art of inventing and constructing objects that please by their intrinsic form and color, addressing itself to buildings in the largest sense of the word, whether inhabited or built only to be looked at, as triumphal arches, mausoleums, domes, towers, and spires." He later naïvely remarks that the requirement that architectural objects must also be habitable causes "many of the difficulties in architecture!"

Consider also the recent viewpoint of an architect on the history of his art: "It is the function of the historian of architecture to trace the origin, growth, and decline of the architectural styles which have prevailed in different lands and ages . . . . Style is defined as character expressive of definite conceptions, as grandeur, gaiety, or solemnity . . . . Style is based upon some fundamental principle springing from its surrounding civilization." Style "is not the result of mere accident or caprice, but of intellectual, moral, social, religious, and even political conditions."

Not a word here about the part which structural knowledge has played in the development of the architectural styles. Not a word about the fact that earlier workers built well because they were in intimate contact with the selection, working, and use of their materials. On the contrary, the modern architect is supposed to create beautiful forms on the drafting board. Structural support and construction are left to engineers.

OUTWORN STYLES FOR NEW MATERIALS

It has been said that a new style is now developing from the skyscraper. Advances in knowledge of materials and structures have made this possible. The development of the classical orders, as already indicated in the case of the stone column, was based on an understanding of structural properties and basic mechanics. The refinement of the arch aqueduct was the result of skill based upon experience and knowledge. The Gothic cathedral was certainly based on a structural knowledge which made possible the construction of a skeleton-stone building, just as the skyscraper style is based on skeleton

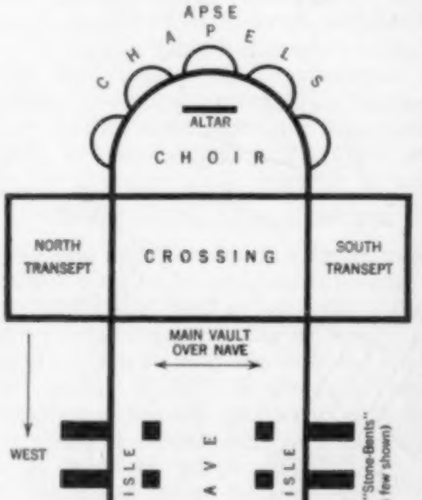


FIG. 2. A TYPICAL GOTHIC CATHEDRAL
Thrust of Vaulting Is Balanced by Flying Buttresses and Piers, Permitting Development of Skeleton-Stone Construction. See Elevation A–A, Fig. 3

steel construction. It is not an accident that all the great styles in architecture—Classical, Romanesque, Gothic, Renaissance—were developed in the early days, when the architect, as well as the engineer, had first-hand information on materials, and was contributing to the advance of structural knowledge.

The architect differs from the engineer primarily in the emphasis he places on function, construction, and form—the three elements of design. He subordinates construction, and even function, to form. The engineer, on the other hand, looks upon form as the final result arrived at through a scientific analysis of function, tempered with constant attention to economy. Any attempt to reconcile these two views seems hopeless. Yet, paradoxically, if both processes were perfect, the result in any particular case should be the same. As a famous American architect, Thomas Hastings, once remarked, "A design which looks right invariably builds well and is economical."

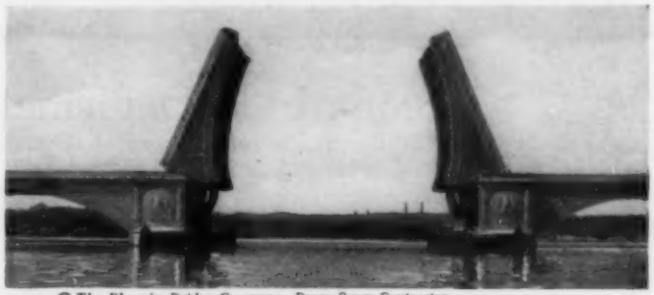
Modern architects know that a perfect work of architecture must be functionally suited to its purpose, and must use materials and methods of construction in a manner which will bring out the inherent possibilities or qualities of beauty which they possess. He is coming to rely less and less on ornament as a means of embellishing forms which are not suitable to their purpose, and to emphasize the simple intrinsic beauty of structures which are perfectly adapted. In short, the modern architect realizes that the production of perfect architecture requires a full knowledge of materials, of methods of construction, and of the possibilities of new forms.

As a matter of fact, many of our architectural schools are undergoing revolutionary changes. The so-called "new architecture" attempts to emphasize the basic principles which have always guided engineering. It insists that buildings shall be functionally designed, that materials shall be honestly used, and that eclecticism, the false decoration of the new with garments stolen from the past, shall cease. The new architecture insists "that frame and garment are essentially one."

Carried to its logical conclusion, this new architecture would end up as civil engineering, for this is exactly what the civil engineer has been doing for centuries—building honestly, precisely, economically, and usefully. The actual accomplishments of the new architecture, however, are not always appealing. Some of the new buildings are, to the engineer, still wilder visions than anything the past has produced.

Fig. 3. Sectional Elevation of a Gothic Cathedral

Showing the Vaulting at A, Supported by the Ribs B, and Braced by the Flying Buttresses C, Connecting with the Buttresses D. The Low Windows at E Constitute the Triforium, While the Clerestory Is Marked F



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The Arlington Memorial Bridge Over the Potomac

The Double-Leaf Bascules Are of Steel Under a Metal Veneer Built to Simulate Masonry. Such Treatment Is Neither Structurally Nor Functionally Honest

Furthermore, some of the radicals of modern architecture must be classed was iconoclasts, destroying the old rather than using it as an inspiration for the new. Let us hope that their well-meaning but sometimes ill-advised use of good material is but a passing fad. Let us hope that at last architecture will come closer to engineering, and will design buildings of a beauty which is only attained by the perfect adaptation of new materials and modern methods of construction.

On the other hand, the modern engineer is beginning to realize that "it is a narrow view of utility which neglects the utility of beauty." Reasonable attention to esthetic considerations must be given in the design of certain engineering structures. There is usually considerable freedom of choice in proportion and form. In many cases great improvements can be made in the esthetic qualities of engineering design by slight changes which will entail little or no increase in cost.

ENGINEERS SHOULD DEVELOP AN ESTHETIC SENSE

It is unfortunately true that whereas the architect is at least attempting to develop a better engineering sense, the engineer has done little to develop a better esthetic sense. Engineers should try to prevent methods from dictating design; should give free play to their creative instincts; and should seek the most pleasing, as well as the most economical form which will meet their needs. They should remember the chief designer who says, when he looks over the young engineer's final drawing, "That does not look right; better check over your calculations." "Looks" still play a part in engineering.

It takes at least four or five years to make an engineer, but it also takes four or five years to develop that background of good taste and artistic appreciation which is essential in the education of the architect. Thus there is still room for the two professions, and the answer to the problem of good design is to be found in cooperation rather than in conflict. Many modern engineering works demand some esthetic consideration, and the consulting architect of broad and sympathetic understanding should be called in to assist the engineer. Similarly, architectural construction must inevitably become more complicated structurally and will thus require analysis and design which only the engineer is competent to undertake. The two great basic professions of the construction industry should therefore renew to some extent those bonds which in the past made them a single profession.

ENGINEERS' NOTEBOOK

From everyday experience engineers gather a store of knowledge on which they depend for growth as individuals and as a profession. This department, designed to contain practical or ingenious suggestions from engineers both young and old, should prove helpful in the solution of many troublesome problems.

Home-Made Deformeters for Model Analysis

By T. Werner
Engineer, Arthur G. McKee Company, Cleveland, Ohio
and Fred L. Plummer, Assoc. M. Am. Soc. C.E.
Associate Professor of Structural Engineering, Case School of Applied Science, Cleveland, Ohio

Much of the present interest in model analysis of engineering structures is directly or indirectly due to the leadership and ingenuity displayed in such studies by George E. Beggs, M. Am. Soc. C.E., of Princeton University. One of his important contributions is a deformeter gage that makes possible quick, accurate, and economical model analyses of highly redundant structures. However, owing to the relatively high first cost of this equipment, many engineers have not been able to make use of it.

One or two modifications of the Beggs apparatus, notably that originated by William J. Eney, makes possible a considerable reduction in the cost of the necessary equipment. A similar device, providing the necessary accuracy at negligible cost, has been developed independently by Mr. Werner, co-author of this article. Two sets of the equipment have been built in a home workshop at a total cost for material of less than one dollar. The time required was about 15 hours per set. The materials required, and all important dimensions, are shown in Fig. 1. The $1/2$ by $5/16$-in. bar can easily be bent cold. The drill rods should be cut with a file and must not be marred or burred. The gluing, using liquid solder, must be done with extreme care.

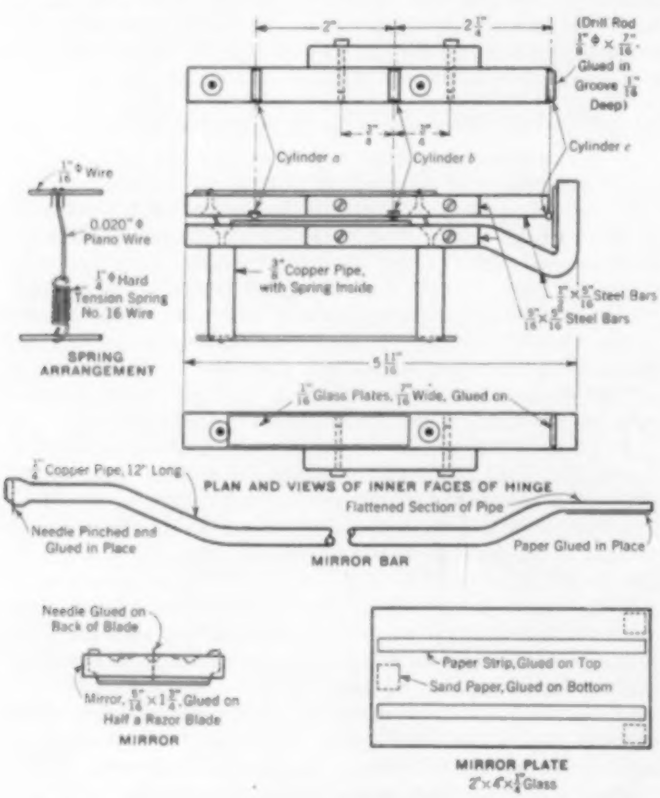


Fig. 1. Details and Principal Dimensions of a Simple Deformeter

The model may be cut from cardboard, celluloid, or other sheet material of uniform thickness and good elastic properties. If, as is usually the case for such models, the principal distortions are due to bending moment stresses, the widths of the model members should be made proportional to the cube roots of the moments of inertia of the actual members. In some cases it may be desirable to make the widths proportional to the areas of the corresponding members. If all members in the prototype are of the same thickness, the model may be cut exactly to scale.

The set-up for a model of a two-span continuous frame is shown in Fig. 2. The apparatus should be placed on a sturdy table with a level, paper-covered top. All lines of reactions, loads, and center lines of the frame members should be drawn on the table. The load lines should be extended at least 16 in. beyond the model frame.

The deformeters—one for each support—are clamped to the table, with the long glass plate accurately set over the horizontal reaction line, and cylinder *b* centered on the vertical reaction lines. The clamps, not shown in the drawing, should be placed on the bent part of the hinge, and should not cover the glass plates.

The model is then clamped under the $5/16$ by $5/16$-in. bars of the deformeters. It should fit the lines on the table exactly. One-quarter-inch steel balls, resting on glass or celluloid plates, are placed under the model, and weights (not shown) on top of it to keep it level.

The mirror bar is then placed by pressing the needle lightly into the model and resting the other end of it on the mirror needle. The razor edge of the mirror should rest on the paper strips on the mirror plate, and the needle point must be vertically above the load line.

A focusing flashlight of good quality is placed as shown in Fig. 2, and a piece of cross-section paper with horizontal lines numbered consecutively is tacked to the wall. The flashlight is turned on and adjusted until a sharply outlined reflection is seen on the cross-section paper. The room should be darkened in order to get accurate readings.

As indicated in Fig. 1, the model support can be moved in three ways. For movement in an axial direction (thrust), fillers of equal thickness are inserted between the cylinders *a* and *b* and the glass plate. For rotation (moment), fillers are inserted between the cylinder *a* and the glass plate. For lateral movement (shear), fillers are inserted between the cylinder *c* and the glass plate.

Small glass plates, about $1/2$ in. by $1\,1/2$ in. by $4/100$ in. thick, are very good fillers. A dozen or more, all of ex-

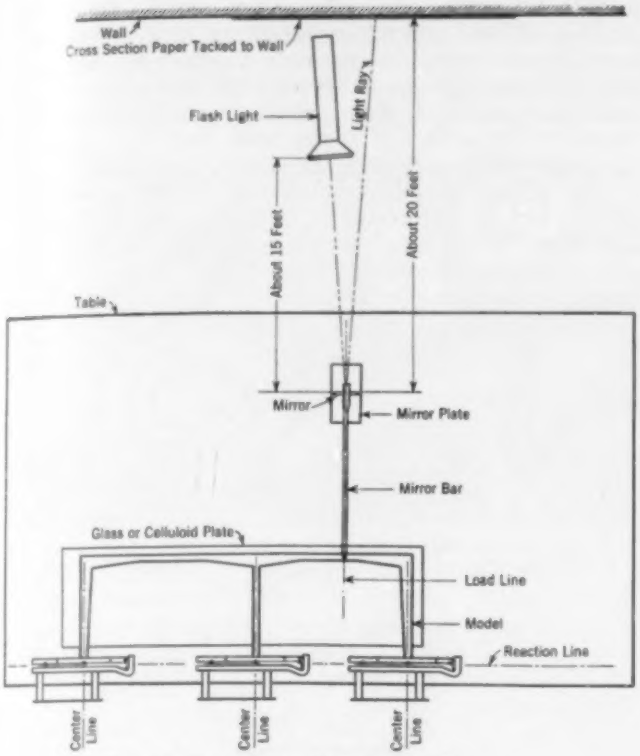


FIG. 2. SET-UP FOR MODEL TESTING

Deflections in the Model Are Magnified by the Tilting Mirror and Measured on the Wall

actly equal thickness, should be on hand. One or more may be inserted at each cylinder in order to secure a fair-sized deflection at the load line.

If "floating" hinges are used, as for instance at the crown of an arch, the model is first clamped at that point to both parts of a deformeter and then cut with a hack-saw. Two glass plates with steel balls between them are placed under the deformeter at the hinge, to provide free movement. The remaining deformeters must be placed on fillers.

All model studies of this type are based on an application of Maxwell's law of reciprocal deflections by which the ratio between any load and its effect (moment, thrust, shear, or stress) at any point, x, may be shown to equal the ratio of the linear deflection at the point of application of the load to the deflection (angular or linear) at point x, when a deformation corresponding to this effect (moment, thrust, shear, or stress) is created at point x by mechanical or other means. Thus any redundant force, R, may always be expressed as a load, P, multiplied by the ratio of two deflections, D/d. By moving one support of a model a known distance, d, in the direction of the desired reaction component (either force or moment), and measuring the deflection D at any load point, the influence value for the reaction component can be computed by simple division.

The deflection D is magnified about 1,000 times with the set-up shown. The actual deflection need not be determined if filler thickness is determined in the same manner as D. This can be accomplished by inserting one filler at cylinders a and b on each hinge, moving the model as a whole a distance equal to the filler thickness. For,

$$\text{Reaction} = -\frac{PD}{d} = -\frac{PD'}{d'}, \text{ and Moment} = -\frac{PD}{d} = -\frac{PD'}{d'} \times K$$

in which D = actual linear deflection in the model at the load point

d = actual linear or angular deflection in the model at the reaction point

D' = deflection as measured on the wall

d' = filler thickness as measured on the wall

K = distance between cylinders a and b, measured to the same scale as the model

d'/K = angular deflection.

Readings and calculations can be readily set up in tabular form. A total of 5 readings, 3 without fillers and 2 with fillers, giving 4 deflection measurements, will be found adequate to determine any one influence value, for any structure. The tabulation must indicate the number of fillers used unless the same number is used for all measurements.

With the set-up shown in Fig. 2, readings may easily be made to 0.1 in. on the wall, or about 0.0001 in. actual deflection. When filler thickness is measured on the wall, the difference in readings is about 40 in.

When the model moves sideways in relation to the mirror beam, the top of the mirror will be pulled toward the model. If this lateral movement is large (greater than 34 in. as indicated on the wall), the resulting error will be sufficiently large to warrant a correction for this effect. It can be easily demonstrated that the error approximately equals the square of the lateral movement as measured on the wall, divided by twice the length of the mirror bar times the multiplication factor ($2 \times 11.5 \times 1{,}000$ in this case). When the mirror turns through an angle B, the light ray will turn $2\,B$. The formula for finding the influence ordinates was based on the assumption that $\tan 2\,B = 2 \tan B$; but if D is over 40 in., the error in this assumption will be over 0.6 per cent, and a correction should be made.

Errors not mentioned here are too small to take into consideration, provided the set-up is accurate and the

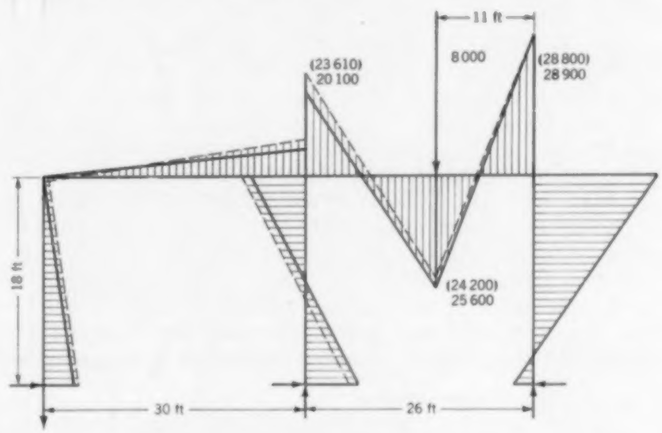


FIG. 3. COMPARISON OF MATHEMATICAL ANALYSIS AND MODEL STUDY OF STRUCTURE SHOWN IN FIG. 2

The Model Was Constructed and Tested in Four Hours by Students Without Previous Experience in This Work

apparatus is made with care. It seems probable that, except for very small forces, the results will check within 10 per cent the forces which exist in the actual structure. It is not probable that any analysis, whether based on model studies or on mathematical studies, which in turn are dependent on many basic assumptions, ever gives results that check the stresses in an actual structure with a greater degree of accuracy.

A set of these deformeters is now in use in the Structural Models Laboratory of the Case School of Applied Sci-

ence. In Fig. 3 is shown a comparison of the moments and reaction values due to a single load applied to the rigid frame of Fig. 2. The dotted lines and the values in parentheses represent the results obtained from an algebraic analysis following the slope deflection method, and the solid lines and the values without parentheses give the results of a model analysis. This work is part of a regular laboratory course, none of the students having had previous experience in the preparation or testing of such models. The model was cut from a celluloid sheet with a coping saw and files. Two 2-hour periods were available for the design and preparation of the model, calibrating the deformeters, testing the model, making all necessary computations, and preparing a brief report (two students work together on this problem). Closer agreement between the two sets of results could be expected of course, if the model had been more carefully prepared and if the tests had been made by someone with experience in the use of the deformeters.

The writers would be pleased to furnish further details to anyone interested in building a set of these deformeters for his own use. This method of measuring deflections can of course be used with Beggs deformeters to eliminate the use of micrometer microscopes.

Arresting a Slide on an Indiana Highway

By G. H. ALLEN, ASSOC. M. AM. SOC. C.E.

DISTRICT ENGINEER, VINCENNES DISTRICT, STATE HIGHWAY COMMISSION OF INDIANA, VINCENNES, IND.

THE rugged terrain in southwestern Indiana is underlain with a deposit of fireclay that causes slides to occur frequently. While they do not reach the proportions of those in mountainous country, these slides do present a problem for the highway engineer. In each case the Highway Commission makes a thorough investigation of the probable cost of line change, as compared to the cost of slide prevention. In general, it has been found cheaper to correct the cause than to relocate the road.

Investigations usually consist of borings supplemented by a contour map of the affected area. Hand augers can be used satisfactorily to a depth of 15 ft in soft material, and give enough information to locate critical points for deeper exploration. For the latter purpose, wash borings are found to be entirely satisfactory, for this method is used extensively in locating coal deposits in the vicinity, and there are many experienced operators who can assist in identifying the materials encountered.

The Horton's Hill slide on State Road 66, 13 miles east of Evansville, is of particular interest because of an abandoned coal mine that was a contributing factor. The road at this point is on a 7 per cent grade from a high hill to the valley, and because of the ruggedness of the surrounding country, relocation seemed impracticable. On March 17, 1933, 203 ft of the pavement dropped 3 ft vertically at a point where it crossed a gully in the hillside on a 19-ft fill. It was thought at first that a mine roof had caved in, as frequently occurs in this area, and the mud jack was sent to raise the pavement back to grade. But the additional load only accelerated the slide, and on March 30 the pavement again settled 3 ft and shifted laterally to the right, while cracks opened up 20 ft to the left of the center line, indicating the sliding of a large mass of earth. Mud-jacking was discontinued and a fill of earth and cinders was placed to keep the road open to traffic. Further movements occurred during April, until the total vertical settlement was 8 ft and the total lateral displacement 15 ft.

Borings were made immediately, and revealed the actual conditions (Fig. 1). There were several mine rooms to the left, some filled with water and others with muck. Men who had worked in the old mine said that these had been the lowest part of it, and had been abandoned on account of the amount of pumping required. The coal seam rested on fireclay, and was overlain with a sloping stratum of yellow clay shale. Between this shale and the surface material was another thin layer of fireclay. Both fireclay deposits were well lubricated—the lower with water seeping out from the mine through the coal and coal bloom, and the upper with hillside seepage. Sliding was taking place on both layers.

It was decided that a drain should be placed to intercept the hill seepage and drain the mine (Fig. 2). As the slope of the pipe would be slight, and as the trench was to be backfilled as construction progressed, it would have been desirable to begin excavation at the upper end, to allow for possible variations in strata between the borings. But the head of water in the mine made it necessary to work from the outlet end. Careful consideration was therefore given to laying the grade line on the plans, and the drain was located below the coal seam to allow for possible unforeseen conditions.

The drain consisted of 174 ft of perforated pipe, 24 in.

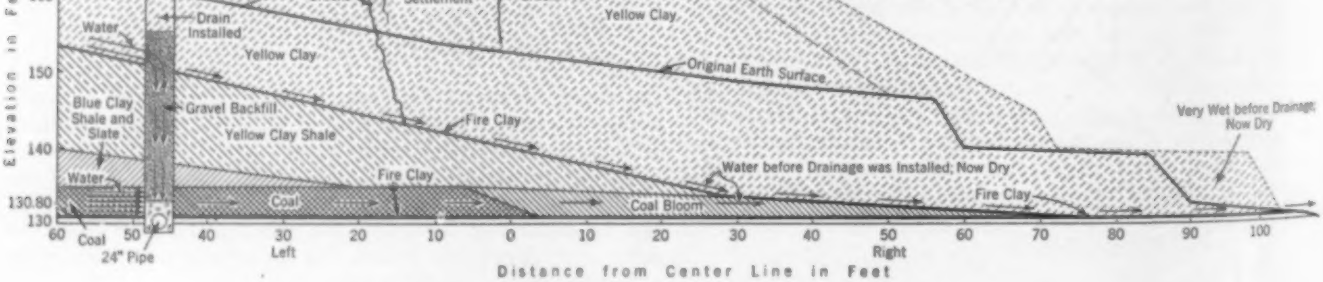


FIG. 1. CAUSE AND CURE OF THE HORTON'S HILL SLIDE

The Fireclay Stratum, Lubricated with Seepage Water, Formed a Sliding Plane. Installation of the Drain Stopped the Movement

in diameter, adjacent to the slide area, and 540 ft of perforated pipe 18 in. in diameter, extending to an outlet in the side ditch. The larger diameter was used adjacent to the slide area in order to facilitate cleaning and inspection, and to intercept more readily the flow from the

A Slide Backfills the Contractor's Trench Somewhat Ahead of Schedule

mine. Bituminous coated corrugated metal pipe with a paved invert was selected on account of the high acid content of the mine water. Four 42-in. diameter manholes with ladder rungs were provided to facilitate inspection. The pipe can be cleaned by dragging a sand bag back and forth between the manholes.

The trench was designed for a 4-ft width in order to give a minimum of 12 in. of gravel fill on each side of the pipe. The pipe was laid and the trench backfilled progressively, so that a minimum amount of trench was open at any one time. The first 8 to 10 ft of depth was excavated by dragline, but the rest of the excavation was hand work and proceeded very slowly because of the number of times the dirt had to be handled. Excavation was followed up closely with sheeting. In one deep section, tight sheeting was used in the upper 14 ft and sheeting with 1 to 5-in. spacings in the next 12 ft. Below this depth, in the shale, no sheeting was used.

Once, while work was going on in the deeper part of the trench, the high bank on the left started to break away and slide. The jacks holding the sheeting were adjusted several times but finally gave way at the top, as shown in an accompanying illustration. The upper part of the sheeting collapsed against the opposite side of the trench and prevented its being filled. After the slide had been removed the contractor was able to replace the sheeting and salvage his excavation. No one was hurt because of the precaution taken by the engineer and contractor in ordering the workmen out at the first sign of danger.

As indicated in Fig. 2, an opening was drilled laterally from the drain to a water-filled room of the abandoned mine. When first released, the water was some 7 ft above the flow line of the pipe and the discharge filled the drain for several days. When the water had drained away, enough gravel backfill was placed in the old mine rooms to prevent the material in the trench from sloughing into them.

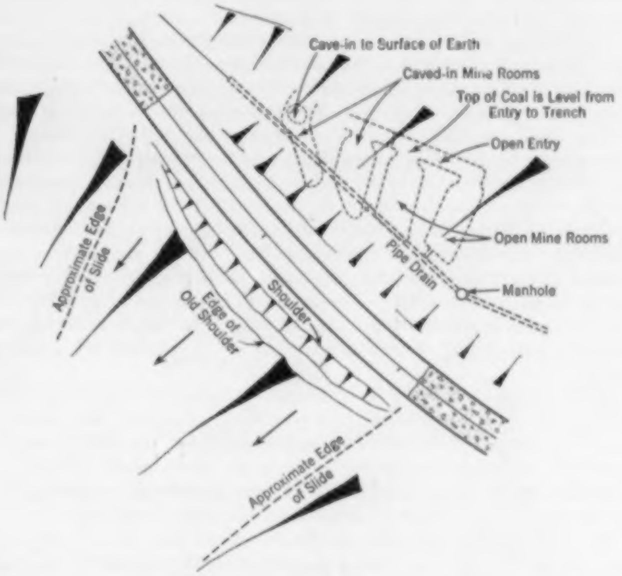


Fig. 2. Principal Features of Horton's Hill Slide Area, near Evansville, Ind.

As the mine had been completely filled with water, there were no gases at first, but later the air in the lower half of the trench became so bad that a cigarette or pipe could not be lighted. The men were alternated at low and high elevations in the trench, and none showed any ill effects. The completed drain and manholes are filled with mine gases at all times, but the air can be made safe by removing the manhole covers the day before an inspection is to take place.

There has been no indication of movement at the point of sliding since this project was completed. The contract price for the work was $10,700.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Stabilization of Soils Not Always Practicable

To the Editor: Here are a few comments on the article on "Stabilized Soil Roads" by C. A. Hogentogler, Assoc. M. Am. Soc. C.E., and E. A. Willis, Jun. Am. Soc. C.E., which appeared in the December 1935 issue of Civil Engineering. Over thirty years ago, in the city of Los Angeles, oiled roads were built of a mixture of oil and adobe, or clay soil. A sheep's foot type of roller, known as a petrolithic tamper, was used for the work. Although these roads gave excellent service for a short time, they deteriorated rather quickly and became rough and rutted after one to two seasons. Thereafter maintenance became difficult and expensive, and further construction of oiled natural soil roads was discouraged.

However, about seven or eight years ago, when it was found necessary to construct a large mileage of low-cost local soil or gravel state roads through desert or lightly traveled districts where automobile traffic was rapidly wearing away the unprotected surfaces, we went back to the extensive use of oil. By experiment it was found that with soils which do not show a high swell or disintegration in the presence of moisture or a greater affinity for

water than for oil, very excellent and durable oil-mixture roads could be built. These have stood up for a number of years under moderate traffic with a relatively light maintenance cost. However, since in some localities it is expensive to import stable material and the soil in its natural condition is unsuitable for treatment with road oils, we have for some time been making studies relating to soil stabilization with bituminous emulsions along the lines described by Messrs. Hogentogler and Willis.

It is comparatively easy to stabilize a decidedly adverse soil as measured by laboratory tests. In fact in the case of a soil from the Imperial Valley, which has the greatest swell of any soil encountered in the state, it was found possible to completely destroy the tendency to swell by mixing with the proper percentage of a stabilizing emulsion. From a practical standpoint, however, there are still many problems to be solved.

In effective soil stabilization with bituminous emulsions, there must be a high percentage of minus 200-mesh material; otherwise, the process will usually be no more effective than with the standard slow-curing type of road oils. The particles must be coated with a thin film of asphalt in order to destroy the tendency to swell. The required percentage of standard undiluted stabilizing emulsion containing approximately 50 per cent asphalt is usually computed on the basis of not less than 15 per cent of the minus 200-mesh material. On this basis a soil with 20 per cent of minus 200-mesh material requires approximately 3 per cent of emulsion. For greater percentages of minus 200-mesh, the percentage of emulsion increases proportionately. For instance, if the soil is an adobe or clay with not less than 50 per cent of minus 200-mesh material, the required percentage of emulsion would be approximately $7^1/_2$ per cent.

With a soil containing less 200-mesh material or less clay than is required to make stabilization effective, it may be necessary to add clay to put the soil in proper condition. In any event, it must be determined whether it is more economical to take an unstable local soil and add the proper percentage of stabilizing bituminous emulsion, or to import a stable material.

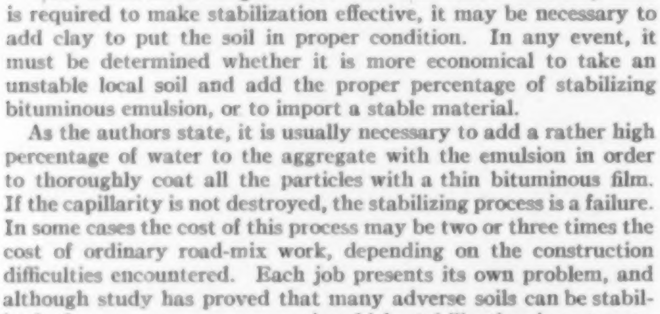
As the authors state, it is usually necessary to add a rather high percentage of water to the aggregate with the emulsion in order to thoroughly coat all the particles with a thin bituminous film. If the capillarity is not destroyed, the stabilizing process is a failure. In some cases the cost of this process may be two or three times the cost of ordinary road-mix work, depending on the construction difficulties encountered. Each job presents its own problem, and although study has proved that many adverse soils can be stabilized, there are numerous cases in which stabilization is not practicable. Each project must be studied on its own merits.

THOMAS E. STANTON, JR., M. AM. SOC. C.E.
Materials and Research Engineer,
California Division of Highways

Sacramento, Calif.
April 26, 1936

Work Relief Planning Projects Should Be Continued

TO THE EDITOR: Mr. Lewis' able paper in the March issue on the subject, "Planning Programs Limited Under Work Relief," treats of some of the necessary limitations on this kind of work,



MODEL OF ST. PAUL'S HOUSING PROJECT
A Plan for Slum Clearance and Low Rent Housing in Which Rents Will Be $4.60 per Room

all of which are possible of correction as he points out. The Minnesota State Planning Board and the local planning boards in three first-class cities—St. Paul, Minneapolis, and Duluth—have taken full advantage of the federal funds provided under CWA, ERA, and WPA for doing city planning research work. The immobility of the officials in the smaller communities or their lack of interest has almost prevented any work of this kind from being done there.

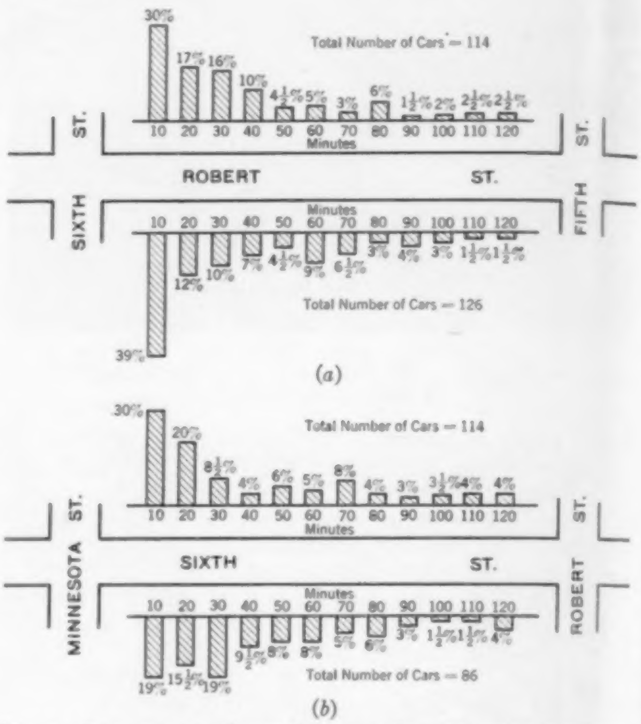


FIG. 1. ILLUSTRATIVE CHART SHOWING CURB PARKING TURNOVER IN ST PAUL
Count Made in 10-Min Periods Between 1 a.m. and 7 p.m., Average Weekday in March 1934

Some excellent work was accomplished in St. Paul during CWA's five-month period of existence. Under ERA and under its successor, WPA, our research work was expanded to cover housing, general city planning, zoning resurvey and mapping, study of land values, industrial and terminal survey, study of population trends and of special assessments in relation to zoning, investigation of recreation and leisure time, a comprehensive traffic survey, and an analysis of accident records. Under ERA for a time we were able to use 20 per cent of our allotment for supervision, but because of the increasing number on relief this supervision was gradually reduced to 6 per cent, the same as that permitted for moving dirt. Under WPA 10 per cent is allowed for supervision, but part of this must come from relief, if possible.

With these setups we were able to complete a city-planning, slum-clearance housing project involving an estimated cost of $4,500,000. A topographic map of these 131 acres was made by competent surveyors and draftsmen, and costs based on the actual design of houses were estimated by engineers and architects. A plaster-of-paris model, 5 ft square, was made to show the completed project. A photograph of the model accompanies this discussion.

A plaster-of-Paris model was also made of the capital approach plan. A survey covering the recreation activities of every organization in the city was completed. In addition, a traffic survey was made to determine the use of streets for parking (Fig. 1), and an analysis of traffic accidents at the forty worst intersections was completed. As the time of the supervisors is entirely taken up by personnel problems and laying out work little can be done towards analyzing the data collected.

City planning is a continuous process, and a limited number of technical, clerical, and professional people on relief could be employed continuously in compiling data and bringing them up to date, not only for the use of the planning board but for other departments of government and for certain business organizations.

With a very slight increase in cost, the data could be made immediately available, whereas now there is a lag of at least a year on most of this information.

In St. Paul we are breaking down the various data that have been collected in relation to the 76 census tracts, into which the Census Bureau has divided the city. This is a monumental task in itself.

As it may be a long time before all professional and clerical white collar workers and salesmen can again be placed in commercial and industrial activities, federal provisions should be made for the continuation, indefinitely, of city planning research projects. Such projects should be reviewed by the state planning boards as to their suitability, and if approved by them and the National Planning Board, they should be set up without further reviewing boards.

George H. Herrold, M. Am. Soc. C.E.
Engineer, City Planning Board of St. Paul

St. Paul, Minn.
April 23, 1936

Present-Day Planning Dependent on Work-Relief Funds

To the Editor: In his paper on "Planning Programs Limited Under Work Relief," in the March issue, Harold M. Lewis, M. Am. Soc. C.E., in general speaks well of the Civil Works Administration program. However, he takes exception to the conduct of county, city, and town planning under the FERA and WPA programs. Although there is much truth in Mr. Lewis' comments, it should be remembered that the very existence of present planning has depended largely on the allocation of funds from the works program.

The National Planning Board, established in July 1933 to study national resources and recommend programs of desirable public works, was financed out of PWA funds. Its successors, the National Resources Board and the present National Resources Committee, have received operating funds from the works program appropriations. Under FERA, state and regional planning boards were financed quite largely out of federal emergency relief funds, at the rate of about $1,800,000 per year.

Mr. Lewis' objections are based largely on the complexity of the procedure imposed on local planning agencies which endeavored to have projects approved. As he indicates, projects entirely or partially statistical in method have been critically examined by the Coordinating Committee of the Central Statistical Board and the Works Progress Administration. Many of these projects have also been referred to the National Resources Committee. Although it is true that such projects deserve consideration for other than statistical features, on the whole much good has been done by subjecting planning proposals to critical and unbiased analysis.

The story of state planning under WPA is especially significant. In response to recommendations of the National Resources Committee, WPA in each state received applications for state projects to supply staffs to state planning boards. For several reasons, this state-by-state application procedure did not prove satisfactory, so on October 4, 1935, the National Resources Committee made application for a nation-wide project to replace the various state projects, none of which had been put in operation. This application was approved, and the new national project was called Federal WPA Sponsored Project No. 3. In this the National Resources Committee is responsible through its state planning consultants for technical proficiency, while WPA handles the business administration. So far (March 30), staffs for this project have been provided to 41 state planning boards. The purpose of this national cooperative project is to ensure an adequate working staff for each state planning board.

Concerning Mr. Lewis' recommendations that "instructions and procedures are needed to govern planning projects," I should like to point out that WPA has prepared Bulletin 29, Appendix A, Supplement 2, which describes the conduct of state planning projects. Furthermore, the National Resources Committee is preparing a series of outlines of recommended procedures for the principal classes of studies commonly undertaken by State Planning Boards. In regard to his recommendations that "the National Resources Committee should be depended upon for intensive review and coordination of state planning projects," it should be noted that precisely this procedure is in operation. The state planning consultants of this Committee review all projects submitted by state planning boards. Mr. Lewis' recommendation that "state planning boards and regional planning organizations should be used for the intensive review and coordination of municipal planning projects," is presumably directed to the state WPA. It is undoubtedly true that, in some instances, the procedure of referring projects to the public planning board having jurisdiction has been overlooked. However, the extent to which it is observed will depend upon the working relations between WPA, the state planning boards, and the various local planning agencies.

There are more persons employed in the technic and profession of planning now than ever before in this country. By far the larger portion of this activity is financed by work relief program funds. Therefore, it would probably be well for those of us who are interested in and make a profession of planning to consider the "limitations of work relief in the advancement of planning programs," as being limitations imposed by ourselves. The "use" we may make of the work program to advance the cause of planning is primarily up to us.

Robert H. Randall, M. Am. Soc. C.E.
Consultant, National Resources Committee

Washington, D.C.
April 30, 1936

Importance of Topographical Mapping Questioned

Dear Sir: In his article, "No Maps in a Mapping Age," in the February issue, William Bowie, M. Am. Soc. C.E., laments the lack of sufficient and accurate topographical mapping of our country and resources. I cannot agree with Mr. Bowie's statement that "There is no more urgent problem before the American people today than to find out just what we have, where it is, and whether it can be utilized." Surely such questions as public education, international relations, or increasing taxation are far more urgent for the preservation of the national welfare. With the national debt mounting to an all-time high and various legislative and political subdivisions already spending more than one dollar out of every three of the national income and no let-up yet in view, I cannot become the least perturbed over a few hundred thousand poorly mapped or unmapped square miles in arid Arizona or mountainous Montana.

The point is also made that this country is "one of the most backward [poorly mapped] . . . of all the highly organized countries of the world," although an accompanying illustration shows 47 per cent mapped by 1934. If swamp lands, mountainous regions, arid areas, and prairie regions are deducted from the unmapped areas, this percentage would be materially higher. As all except the last of these areas are of little commercial importance at present and a highly detailed map is not therefore necessary, the mapping situation in this country is far better than the "47 per cent" indicates. I must also emphasize that the various unmapped areas are not unexplored and unknown—general terrain, kinds of soil, and usually the potential natural resources are known in detail to the various state geology survey departments or to bureaus of the U. S. Geological Survey in the various states in which areas are located. If more detailed data were required, they could be obtained more easily, accurately, and economically by aerial photography and local reconnaissance when needed than by depending on maps made now that would be outmoded by the time information was needed.

With regard to the necessity for mapping in soil erosion work and in preserving timber lands, it would seem that aerial mapping with contours adapted therefrom would suffice. Also, fundamental instruction of the land owner or tenant as to the cause of and remedy for erosion and forest destruction would be a more logical method of approach than trying to glean from accurate topographical maps where conditions may or will occur. Aerial mapping should be most economical and sufficiently accurate for this type of work, besides providing first-hand (photographed) information of the terrain. For problems of the forests, soils, and

streams, no map can contain all the necessary information. Knowledge of the vegetation and its characteristics is highly important, as it does not remain constant or uniform.

I do not dispute the advisability of conservation; but try to convince a steel manufacturer or any other heavy user of raw materials to use materials which will increase his unit costs by even a small amount, when it is economically possible to do it cheaper by using other materials, merely on the argument of saving some of the better materials for future generations! Today our economic schemes of production do not work that way. As long as the production of goods for individual profit is permitted in a competitive and unrestrained market, the never-failing laws of supply and demand will use first those resources which are best and cheapest, whether they be power, fuel, or minerals.

In coming generations new discoveries and progress in science and the art of invention will develop uses for now apparently worthless commodities as well as find substitutes for exhausted resources of coal, petroleum, iron, and other minerals, if such eventualities ever occur. Immense unexploited resources in South America, Asia, Alaska, and possibly Antarctica will also become available in time through the economic laws of supply and demand. In the meantime there are far more important questions demanding our attention.

LYNDON F. KIRKLEY, Jun. Am. Soc. C.E.

Bethlehem, Pa.
April 23, 1936

Additional Charts for Beams with Hydraulic Loadings

TO THE EDITOR: Apropos of the article by J. C. Stevens, M. Am. Soc. C.E., on "Bending Moments in Beams with Hydraulic Loading" in the March issue, the accompanying charts may be of interest. In Fig. 1, the shears and bending moments may be found at any point in a triangularly loaded beam, and in Fig. 2 the same stresses may be found for trapezoidal loads. For Fig. 1, for a beam length l, of which l_1 is loaded, and for a maximum load intensity of w per unit length, the expressions for shear V and bending moment M at any section A are found to be

$$V = \left[\frac{1}{2}\left(\frac{x}{l_1}\right)^2 - \frac{l_1}{6l}\right]wl_1 = Swl_1$$

$$M = \left[\frac{x + l - l_1}{6l} - \frac{1}{6}\left(\frac{x}{l_1}\right)^3\right]wl_1^2 = Kwl_1^2$$

The chart solves S and K, using scales $\frac{l_1}{l}$ and $\frac{x}{l_1}$. It is to be noted that there is one $\frac{x}{l_1}$ scale to be used in determining S, and another for determining K, and a common $\frac{l_1}{l}$ scale. The straight dashed lines show the use of the diagram for a beam loaded triangularly over 0.7 of its length. To solve for shear and moment at any section, straight lines are drawn from the point $\frac{l_1}{l} = 0.7$ through the points on the $\frac{x}{l_1}$ scales to give the required values of S and K on the latter scales. Thus the maximum values for S are $+0.383$ and -0.117, and the maximum value of K is 0.0875, which occurs at approximately $\frac{x}{l_1} = 0.48$.

In the case of Fig. 2, for a beam of length l, with a load of unit intensity w at one end of the beam, and rw at the other end, the formulas for shear and bending moment at any section A are found to be

$$V = \frac{1}{6}\left[1 + \frac{2}{r} - \frac{6}{r}\frac{x}{l} - 3\left(1 - \frac{1}{r}\right)\frac{x^2}{l^2}\right]rwl = Srwl$$

$$M = \frac{1}{6}\left[\left(1 + \frac{2}{r}\right)\frac{x}{l} - \frac{3}{r}\frac{x^2}{l^2} - \left(1 - \frac{1}{r}\right)\frac{x^3}{l^3}\right]rwl^2 = Krwl^2$$

The chart solves for S and K, there being one common scale for r and two separate scales for $\frac{x}{l}$ for the two unknowns. The method of solution is the same as for Fig. 1, a straight line joining the correct value of the r scale with the given value $\frac{x}{l}$ intersecting the S (or K) scale at the correct solution.

For example, in a 20-ft span, with the loading increasing uniformly from 450 lb per ft at the right to 1,350 lb per ft at the left, let it be required to find the shear and bending moment 16 ft from the right end. Here $r = \frac{1{,}350}{450} = 3$, $\frac{x}{l} = 0.8$. For S, a straight line joining $r = 3$ on the r scale, and $\frac{x}{l} = 0.8$ on the left $\frac{x}{l}$ scale, cuts the S scale at $S = +0.20$ giving shear $V = 0.20 \times 3 \times 450 \times 20 = 5{,}400$ lb. For M, a straight line from $r = 3$ to $\frac{x}{l} = 0.8$ on the right $\frac{x}{l}$ scale cuts the K scale at $K = 0.059$, giving $M = 0.059 \times 3 \times 450 \times 20 \times 20 = 31{,}860$ lb-ft. The reactions may be found by finding V at $\frac{x}{l} = 0$ and 1.

F. M. WOOD
Montreal, Canada *Assistant Professor of Civil Engineering*
May 6, 1936 *McGill University*

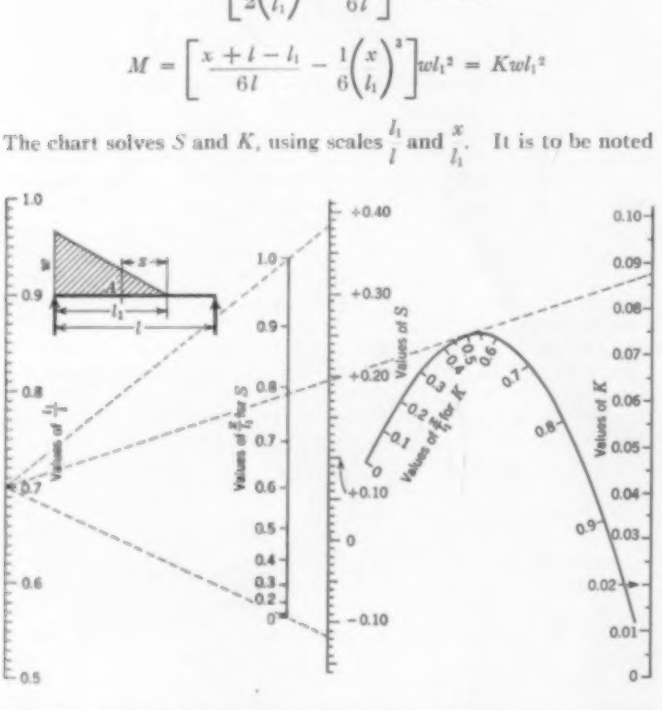


FIG. 1. COEFFICIENTS FOR SHEARS AND MOMENTS IN SIMPLY SUPPORTED BEAMS WITH TRIANGULAR LOADS

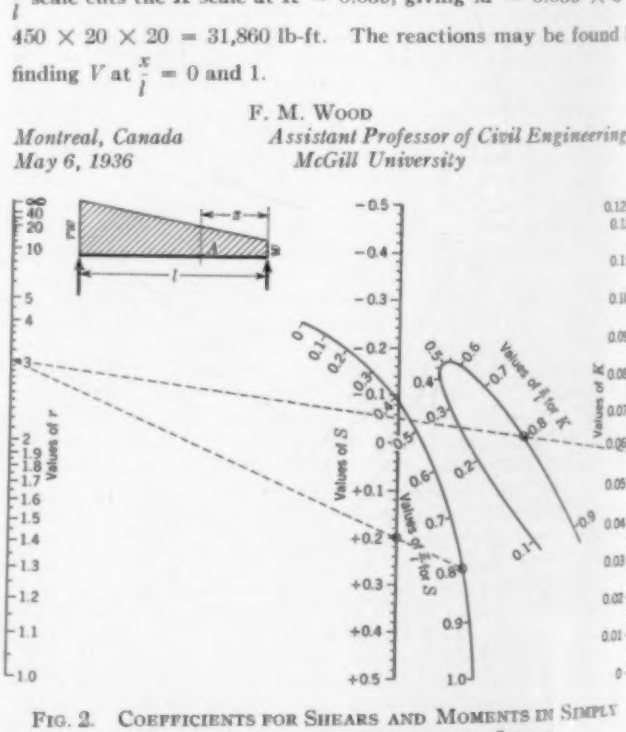
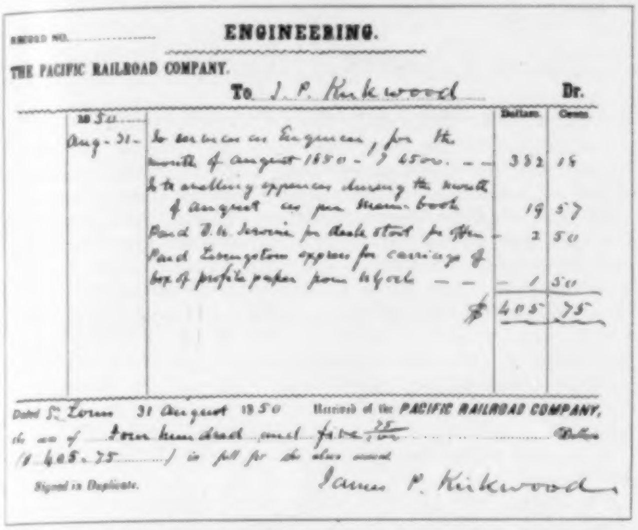


FIG. 2. COEFFICIENTS FOR SHEARS AND MOMENTS IN SIMPLY SUPPORTED BEAMS WITH TRAPEZOIDAL LOADS

More About James P. Kirkwood

To the Editor: In connection with the item on James P. Kirkwood, President of the Society from 1868 to 1876, in the "Society Affairs" department of the May issue, the accompanying illustration may be of interest. This is a facsimile of a receipted voucher


ENGINEERING.

THE PACIFIC RAILROAD COMPANY.

To J. P. Kirkwood Dr.

1850		Dollars	Cents
Aug. 31.	To services as Engineer, for the month of August 1850 – [illegible]	332	18
	To travelling expenses during the month of August as per memo book	19	57
	Paid [illegible] for desk stool for office	2	50
	Paid Livingston express for carriage of box of profile paper from N York	1	50
	$	405	75

Dated St. Louis 31 August 1850 Received of the PACIFIC RAILROAD COMPANY, the sum of Four hundred and five 75/100 Dollars ($ 405.75) in full for the above account

Signed in Duplicate. James P. Kirkwood

Receipted Voucher for Kirkwood's Salary and Expenses During August 1850

for Kirkwood's salary and expenses as chief engineer of the Pacific Railroad Company during the month of August 1850.

W. J. Burton, M. Am. Soc. C.E.
Assistant to Chief Engineer,
Missouri Pacific Railroad

St. Louis, Mo.
May 1, 1936

Classification of Higher Positions

Dear Sir: In an article in the March issue, John C. Hoyt calls attention to the subject of "Classification and Compensation of Federal Engineering Positions." In a subsequent discussion it is stated that in the smaller states and small private organizations the administrative responsibilities involved would be relatively limited as compared with those in the large states and large private organizations. This reflects a point of view that is very common among those who deal with personnel classification. From the quantitative standpoint, it is a reasonable statement. From the qualitative standpoint, it is open to serious question. It is the cause of many serious classification errors.

Another contributor to Civil Engineering brings out the fact that in the lower levels of each job there is a concept of duty which limits activity, but this concept gives way to one of responsibility and expert service in the higher levels. This is correct. Every position is a combination of duties which, as a rule, are easily described, and responsibilities which it is difficult either to describe or to evaluate. It follows, both as a matter of theory and as a matter of practice, that it is not difficult to classify positions in which the aspects of duty dominate with a high degree of accuracy, and to do this to the definite advantage of the personnel and of the organization. In this field the work that was done by the Personnel Classification Board, and that is now being done by the Civil Service Commission, warrants the careful consideration of any organization interested in classification.

The application of any system of classification to positions, in which responsibilities rather than duties dominate, is neither as simple nor, in the nature of the case, can it be as accurately applied. Quantitative considerations are largely useless. Qualitative considerations are intangible, and their relative value as an influence on the success of an organization is very difficult to determine. Nor does the size of an organization have a great deal of bearing on them. It is just about as difficult in a small organization as in a large one to make correct decisions on policies, to devise correct procedures, to outline progressive practices. From the quantitative standpoint, the amounts at stake are smaller, but the need for "quality" in the service the individual renders, and its importance to the life and to the efficiency of the organization in which he works, is not measurably reduced by subtractions from the size of the organization in which he works.

As a result of my experience with these matters, and as a result of my study of the efforts so far made toward improving personnel classification and classification methods, I feel that classification, at this stage in its development, has been dominantly a description of duties. This fact has militated against the completely successful application of classification to positions involving special expertness and to positions involving executive and administrative discretion. In such cases, statements of duties are of far less importance than statements of the degree of expertness, or of the character of the executive or administrative responsibility that is involved.

Washington, D.C. J. L. Harrison
May 10, 1936 *U. S. Bureau of Public Roads*

Joint Technical Sessions Desirable

To the Editor: Ten years ago, the Western Washington Section of the American Society of Mechanical Engineers initiated a joint meeting of local branches of the four Founder Societies. This year the Seattle Section of the Society took its turn in sponsoring the eleventh annual joint meeting, the third that it has sponsored.

I feel that this custom of the Founder Societies in western Washington is worthy of emulation by other regions. As stated by Ernest Hartford, assistant secretary of the American Society of Mechanical Engineers, in a note of congratulation to the Section, "This is a fine move to bring about professional consciousness."

After all, we are professional engineers rather than civil, electrical, mining, or mechanical engineers. Why shouldn't we all pull together as do our friends in the medical profession? They accomplish their purpose through the American Medical Association, and not through a group of nose specialists pulling one way and a group of ear specialists pulling another. The purposes of our groups are just as closely related as are those of the stomach specialists and liver specialists. Why shouldn't the various engineering organizations in every community meet at least once each year as professional engineers?

Seattle, Wash. Fred H. Rhodes, Jr., Assoc. M. Am. Soc. C.E.
April 30, 1936 *Secretary-Treasurer, Seattle Section*

Control Surveys Are of Lasting Value

Dear Sir: In articles and discussions on the use of geodetic control for highway surveys, in the December and subsequent issues of Civil Engineering, it has been stated that such control is of "considerable" value to the various agencies engaged in surveying and mapping as well as to other organizations. The practical value of such methods for highway organizations has, however, been questioned.

From a broad viewpoint, it should be asserted that control surveys are of incalculable and lasting value to an industrial civilization in crying need of more and better maps. Control surveys, of course, are a step toward the realization of maps. A comprehensive topographic map of the country would save millions annually.

The same broad viewpoint would not tolerate the questioning of a basic improvement costing but one-tenth of one per cent of total highway costs—an improvement of sound immediate value that will greatly further the eventual realization of the needed map. As William Bowie in his article on "No Maps in a Mapping Age," in the February issue, points out, a state highway engineer has stated that if a complete topographic map were available, the reduction in his highway department costs would annually almost cover the cost of that map.

A narrow viewpoint in engineering is responsible for the execution of countless surveys that are worthless except for a slight momentary use or local need. The costs of these, if pooled, would soon amount to that of a truly comprehensive map of the country. Forethought, planning coordination, slight betterments in method and extensions of scope, use of uniform practice and a common datum—these together would soon gather momentum in the right direction, and the nation would have a better mapping program.

E. B. Roberts, Assoc. M. Am. Soc. C.E.
Lieutenant, U. S. Coast and Geodetic Survey

Boston, Mass.
May 8, 1936

SOCIETY AFFAIRS

Official and Semi-Official

Sixty-Sixth Annual Convention Opens July 15th

Portland Program to Feature Professional Activities of the Society and Papers on Large Projects in the Northwest

FEW MEETINGS of the Society have offered a schedule of events so varied and attractive as that of the Sixty-Sixth Annual Convention, which opens in Portland, Ore., on July 15. For in addition to the pleasure of a vacation in one of the most famous playgrounds of the nation, and the customary opportunities for renewing old acquaintanceships and forming new ones, those in attendance will have the unusual opportunity of seeing in progress of construction three of the most impressive engineering projects in the world—the dams at Fort Peck, Bonneville, and Grand Coulee. The unusual features of these structures will also be the subject of papers to be presented at the Technical Division sessions.

MT. HOOD SEEN FROM LOST LAKE

The Convention itself will follow the customary schedule, with the first day given over to business and meetings of a general nature, and the President's annual address. Technical sessions will occupy the entire second day, and trips to points of special interest have been arranged for the week-end. Banquets, a dance, and special entertainment for the ladies round out the program.

The general meeting on Wednesday, July 15, will depart from the usual plan, and instead of treating a technical subject will feature a symposium on the professional activities of the Society, with reports by the committees on Registration, Salaries, Fees, Aims and Activities, and Education of the Public, and a survey of the problems and status of professional reemployment. Attention will also be given to the work of the Committee on Professional Development of the Engineer's Council for Professional Development, and to the work of the American Engineering Council and the Construction League of the United States. A dinner and entertainment are scheduled for the evening.

On Thursday the Power, Construction, and Waterways Divisions will meet in joint session both morning and afternoon to hear and discuss papers on Grand Coulee, Fort Peck, and the Columbia River projects. The Sanitary Engineering Division has planned a program that includes papers on stream pollution, municipal water supply, and mosquito control. In joint session, the Highway and Structural Divisions will consider a group of papers describing the unusual features of five large bridges. A separate session of the Irrigation Division, devoted to problems of special importance in irrigation projects of the Northwest, is also on the schedule.

A banquet and dance for members and their ladies will be given in the evening.

On Friday, July 17, there will be an all-day motor excursion to Bonneville. Saturday a similar trip will be made to Grand Coulee, with alternate shorter trips arranged for those whose interests are along other lines. One of these is a visit to the sources of the Portland water supply; another, an inspection of the Ariel hydroelectric development on the Lewis River; and a third, a visit to a large logging and lumbering camp.

The general committee in charge of arrangements for the Convention is under the chairmanship of J. C. Stevens, M. Am. Soc. C.E. Mrs. L. Griswold heads a women's committee whose plans for entertaining the visiting ladies already include an attractive series of social events. The chairmen of other subcommittees on arrangements are E. B. McNaughton, O. E. Stanley, B. S. Morrow, C. I. Grimm, J. W. Cunningham, C. P. Keyser, and J. H. Polhemus.

CONVENTION TOUR

For many in the East and Midwest, the Convention program will begin on July 5, with the departure from Chicago of the specially arranged Convention tour. They will be joined by others the following day in the Twin Cities, and will arrive on July 7 at Fort Peck, where the day will be given over to inspection of the dam. On the eighth, the party will arrive at Glacier National Park. Motor trips on the following two days will include visits to Two

PORTLAND FROM THE AIR
The Willamette River Bisects the City

A PLAYGROUND IN A BEAUTIFUL SETTING
West Hills Public Course near Portland

Medicine Lake, the Blackfeet Indian Reservation, St. Mary's Lake, and Logan Pass. The night of the tenth will be spent in Spokane, and on the eleventh the party will motor to Grand Coulee Dam.

A night trip by train will bring the tourists to Portland on the morning of July 12, with three days before the opening of the Convention in which to visit such points of interest as Mt. Hood and the Hood River Valley.

It is important for anyone planning to join the party to make reservations for himself and guests at the earliest possible date. Extremely economical rates, covering all expenses en route to Portland, and hotel room for the duration of the Convention, have been arranged. A folder giving detailed information in regard to these rates, and a complete schedule of the tour, will be mailed to any member on request either to Society Headquarters or to Leon V. Arnold, 36 Washington Square W., New York, N.Y., who is handling all details of the arrangements.

Flood Pictures Wanted

One of the important features of the Society's Fall Meeting in Pittsburgh in October will be an evaluation of the engineering aspects of the recent floods. While these disasters were particularly severe in the Ohio Valley and thus lend point to study at Pittsburgh, yet they also took on the nature of catastrophes throughout the entire northeast section of the country. It is proposed, therefore, as an integral part of the engineering program of the meeting, to display and discuss those features of the floods which have an engineering implication.

Photographs are desired to illustrate these studies, and members of the Society are urged to submit them. Spectacular subjects concerned with danger to life and property are frequently emphasized in the daily press; but these, although important, are not the illustrations desired in the present instance. The views may be dramatic but their particular purpose should be to illustrate the value or the shortcomings of the works of man in dealing with the unrestrained forces of nature. How did structures withstand or fail to withstand the flood? Perhaps they tended to alleviate conditions or they may even have aggravated dangers already great. Whether the structures shown were helpful or harmful, photographs or drawings illustrating their behavior in the emergency will be most acceptable.

Views showing what the structures did to the floods and what the floods did to the structures are the sort wanted. Please send them immediately to Headquarters. Any mailing charges will be gladly refunded, and the photographs will be returned promptly when they have served their purpose.

In This Issue . . .

Secretary's Abstract of Executive Committee Meeting

On April 20, 1936, the Executive Committee of the Society met at Hot Springs, Ark., with President D. W. Mead in the chair. Present were George T. Seabury, Secretary, and Messrs. Eddy, Riggs, Sawyer, and Tuttle.

Approval of Minutes

The minutes of the meeting of the Executive Committee held on January 16, 1936, were approved.

Members in Arrears

Advisable procedure to be followed in the case of members in arrears of dues for 1935 and of those desiring reinstatement was discussed, and recommendations were adopted for submission to the Board.

Traveling Expenses on Society Business

As directed by the Board, the Executive Committee studied the desirable changes in payment of expenses to Board members and others on Society business. New methods of procedures were recommended for adoption by the Board.

Requests for Appropriations

Various requests for appropriations were presented and, in each instance, recommendations for Board action were made.

Society Property

Appropriate action was taken in connection with various items of Society property, including securities.

Routine Matters

Other administrative details requiring the action of the Executive Committee were presented, discussed, and the advisable action determined.

Meeting of Board of Direction—Secretary's Abstract

On April 20 and 21, 1936, the Board of Direction met at the Arlington Hotel in Hot Springs, Ark., with President D. W. Mead in the chair. In addition, Secretary Seabury and the following members of the Board were present: Past-Presidents Eddy and Tuttle, Vice-Presidents Riggs, Sawyer, Lupfer, and Dennis, and Directors Arneson, Barbour, Burdick, Crawford, Etcheverry, Ferebee, Finch, Hill, Leisen, McDonald, Morse, Myers, Poole, Proctor, Stabler, Trout, and Wilkerson.

Approval of Minutes

The minutes of the meetings of the Board held on January 13–14, 1936, and January 16, 1936, were approved.

The minutes of the meeting of the Executive Committee held on April 20 were also approved and the actions outlined therein adopted as actions of the Board, except for certain items which were considered and acted upon separately.

Amendment to By-Laws

Final action was taken in accordance with the Constitution whereby Article V (Student Chapters), Section 7, of the By-Laws, was amended to read as follows:

"7. Among the privileges offered to the members of Student Chapters are:

"(a) Individual subscription to the Proceedings of the American Society of Civil Engineers at a special price of \$3 per year; group subscriptions of six or more, at the rate of \$1.50 each per subscription period."

Rules for Freeman Traveling Scholarship

Report was received from the Committee on the Freeman Scholarship relative to eligibility for that honor. As a result, the Board adopted the recommendation, somewhat broadening the scope of eligibility for future awards.

Future Meetings

Invitations to the Society to hold quarterly meetings were received from a number of cities and referred to appropriate committees handling these meetings.

Proposed Quoddy Section

A petition was received in proper form, requesting authority for the formation of a Local Section to be known as the "Quoddy Section," at Eastport, Maine. Approval was given tentatively.

Colorado Section Amends Constitution

Approval was given to the request of the Colorado Section that its Constitution be amended relative to terms of office, date of annual meeting, and other details.

Election of Appointive Officers

In accordance with the Constitution, the yearly appointment of Society officers was considered. The following were unanimously reelected: Secretary, George T. Seabury; Treasurer, Otis E. Hovey; and Assistant Treasurer, Ralph R. Rumery.

Committee Reports

Reports were received from the following Society Committees: Publications, Research, Juniors, Districts and Zones, Local Sections, Student Chapters, Public Education, Registration of Engineers, Salaries, and Classification of Engineers.

Financial Matters

Reports were received from the Executive Committee with recommendations with regard to adjustments in Committee and Division appropriations, mileage, and arrears of dues. These were adopted by the Board.

Appreciation of Employees

In recognition to Miss Carolina Crook for thirty years' continuous service with the Society and to Miss Mary C. Moorman for twenty-five years, each was granted three months leave of absence with pay and the formal thanks of the Board.

Memoirs of Honorary Members

Appointment of committees to prepare memoirs of the late Onward Bates and Charles L. Strobel, Honorary Members, was authorized.

Professional Conduct

The Board considered two cases submitted by the Committee on Professional Conduct.

Interpretation for Local Section Allotments

Based on the report of the Committee on Local Sections, the Board adopted an interpretation of the term, "engineering work," as used in the rules for allotments to Local Sections. Details are noted elsewhere in this issue.

Clarifying Salary Report

Resolutions were received from the Sacramento and Los Angeles Sections requesting of the Board an official interpretation of the published salary schedule "as intended only for a guide by which to improve the salaries of engineers on relief work." As a result of full discussion, the following action was adopted:

"*Resolved*, that the reports of the Committee on Salaries, approved by the Board of Direction, wherein it was intended to set forth the prevailing rates of salaries of civil engineers as of the first quarter of 1934 and as published in CIVIL ENGINEERING, first in April 1934, later, in revised form, in August 1934, and again as a separate in May 1935, are

"(1) to be understood to be statistical studies of salaries current in 1930 and early 1934 among a large group of highway engineers; and

"(2) are to be understood to have been prepared to aid in improving the salaries then being paid engineers engaged on relief work; and

"(3) that the salaries indicated in those reports are not indicative of the higher salaries appropriately to be paid engineers at the present time."

It was further voted that in any reprinting of the separate leaflet the part relating to salaries shall be set apart from that relating to fees and shall be accompanied by these interpretations of the Board. [See page 14 of the rear advertising section of this issue.]

Membership Committee

The Board took action on 85 cases of membership admission and transfer, specifically reported to it by the Committee on Membership Qualifications.

Communications from other Organizations

Brief reports outlined the activities of associated bodies, including United Engineering Trustees, Inc., the Engineering Foundation, American Engineering Council, and the Construction League of the United States.

Code of Conduct

To the Committee on Professional Conduct was assigned the study of the desirability of formulating a general code of conduct for members of the engineering profession and if considered advisable, the formulation of such code.

Miscellaneous Matters

Various other matters of an administrative nature were discussed and acted upon.

Adjournment

The Board adjourned to meet in Portland, Ore., on July 13, 1936.

Clarifying Provisions for Section Allotments

SINCE JANUARY 16, 1933, allotments to the Local Sections have been computed in accordance with a set of rules recommended by a special committee of the Board of Direction and adopted by the Board on that date. The formula for determining the amount of an allotment contains factors for the number of paid-up members in the Section, the total amount of local dues collected by the Section during the calendar year, the number of technical meetings held during that period, the geographical character of the Section—whether state or regional, or whether confined to a relatively small center of population—and a constitutional top limit of $3.00 per member.

In determining the factor for the number of technical meetings, the Committee on Local Sections has been faced by an increasing number of Local Section meetings at which there were featured subjects which could not be sharply defined as technical. The committee recently decided that the number of moot questions in this factor deserved careful study and amplification in the rules, which has resulted in the following memorandum as to what constitutes a "technical meeting." This was prepared by the Committee on Local Sections and adopted by the Board of Direction on April 20, 1936.

"A technical meeting shall be deemed to be one at which some engineering work is discussed. Engineering work shall be interpreted broadly to include the following and like subjects:

"1. Engineering research, design, and construction in general, or as applied in specific cases.

"2. Scientific subjects dealing with matters having some application to, or relationship with, engineering, such as meteorology, biology, physics, chemistry, astronomy, etc.

"3. Subjects relating to the production, manufacture, and use of materials and equipment employed in engineering and industry.

"4. Economic problems having engineering and social aspects, such as transportation, flood-control, power, stream pollution, and the development and conservation of natural resources.

"5. Legal and sociological problems relating to engineering, construction, and industry, such as arbitration of disputes, labor policies, etc.

"6. Talks on historical subjects, travel, etc., when embodying engineering interest.

"7. Professional matters, such as ethics, engineering education, licensing of engineers, etc., also Society activities formally presented by an officer or director of the Society or a member of Headquarters staff.

"Note: Social meetings (smokers, dances, picnics, etc.) shall not be classed as technical unless held in connection with discussions coming within the above categories."

Current Projects of Engineering Foundation

ACTIVITIES of the Engineering Foundation for the first quarter of 1936 covered a wide variety of projects, including many of importance to civil engineers. Assistance to the Society's Committee on Earths and Foundations made possible the continuation of experimental work in various places. The study of plasticity of metals, in progress at the University of Pittsburgh, is also proving of practical value, and a report thereon is being prepared. In the field of cement and concrete research, the possibility of organizing and financing a comprehensive program for the coordination of research efforts is being thoroughly investigated.

Non-technical projects, mainly under the direction of E.C.P.D., also received considerable attention. The work of accrediting engineering schools continued, with committees visiting and examining the curricula of many colleges in the New England and Middle Atlantic district. A manual on student guidance was drafted for the assistance of local sections of national engineering societies. Work on the selected bibliography of engineering subjects is nearing completion, and a pamphlet is being drafted for senior students of engineering, suggesting studies that will help them to cope with the professional situations they will meet in practice.

Notes on a Successful Spring Meeting

Good Attendance, Notable Papers, and Fine Excursions Mark Hot Springs Gathering

APPROXIMATELY 400, including members and their families, guests, and members of Student Chapters, attended the Spring Meeting of the Society held at Hot Springs, Ark., April 22 to 25, inclusive. Headquarters for the meeting was at the Hotel Arlington, situated on one of the boundary lines of the Hot Springs National Park.

In substance and in location, the various technical topics were limited to the Mississippi Valley. But this hardly proved a restriction, for the subject matter ranged from transportation, flood control, and power, to sanitation, water supply, dams, and bridges, while the projects involved extended from the headwaters of the Mississippi basin to the Gulf.

Featuring Mississippi Valley Development

For three days prior to the opening session of the regular program, the Board of Direction and its committees were engaged in meetings. Reports will be found elsewhere in this issue. The Spring Meeting proper was called to order in the grand ballroom of the Hotel Arlington, on Wednesday, April 22, at 10 o'clock. Mayor Leo P. McLaughlin welcomed the Society to Hot Springs, and another welcome was extended by Thomas J. Allen, Jr., superintendent of the Hot Springs National Park. D. W. Mead, President of the Society, responded to both on behalf of the Society.

One of the highlights of the meeting was a note of optimism expressed in papers presented by several industrialists who were on the program, among them H. C. Couch, president of the Arkansas Power and Light Company; L. W. Baldwin, M. Am. Soc. C.E., president of the Missouri Pacific Railroad; and Colonel T. H. Barton, president of the Lion Oil Refining Company.

All the technical sessions were well attended, and interest in the papers ran high because most of them dealt with problems concerning the Mississippi Valley, the Mid-South, and the Southwest regions, where the activities of most of those in attendance were centered. The morning and afternoon sessions on Thursday, April 23, were devoted to Division meetings, and many excellent papers, discussing civil engineering projects of high importance to the South and to other regions of the country, were presented. A meeting of the Sanitary Engineering Division, at which three papers were presented, was held in the morning and attracted an enthusiastic audience. Another morning meeting, which adjourned for luncheon and reconvened in the afternoon, was that of the Waterways Division. The three papers offered by this Division were followed closely inasmuch as waterway developments are of vital importance to those in the Mid-South and adjacent states.

On Thursday afternoon three papers were presented by the Construction Division, rounding out a day of excellent technical discussion. Thus, during the day, nine papers were presented in all, and each group was followed by general discussion from the floor.

For abstracts of the various engineering papers, reference may be made to the forthcoming July issue, whose technical contents will be devoted to the interesting subjects discussed at Hot Springs.

Local Section and Student Activities

On Tuesday afternoon, just before the meeting sessions proper, delegates and others from the southern group of Local Sections met to discuss mutual problems and various Society activities of interest to the Sections. An extensive and valuable interchange of ideas repaid their efforts. All in attendance participated.

Similarly student members, whose accommodations had been arranged for at the Hotel Howe, a short distance from the Arlington, attended a conference of representatives from Student Chapters of the Society on Thursday afternoon, April 23. About 65 enthusiastic members of Student Chapters, of college faculties, and of Society committees attended the meeting.

Entertainments Provided

A dinner dance, at which every table in the ballroom at the Hotel Arlington was filled, was held on Wednesday evening, April 22. A special program of entertainment, which included an address on "How to Run the U. S. Government," by ex-senator Ezra, a chin-whiskered prototype of the comic pages, and a brilliant discourse on "The Sucker," by H. T. Harrison, as well as professional singing and dancing, proved to be popular features of the evening. The formal dance that followed was greatly enjoyed, particularly by the younger element.

Another program of entertainment for members, ladies, and guests, was arranged for Thursday evening at the Club Belvidere, located in hilly woodlands about five miles from the hotel headquarters. Dancing followed dinner, and professional entertainment was provided at intervals.

Several teas, card parties, and other forms of entertainment, including some interesting sight-seeing trips, were arranged for women visitors by the Ladies Reception Committee and the Ladies Hot Springs Local Committee. All reports agreed that the guests enjoyed these features.

Notable Mississippi River Trip

On Friday, April 24, a party of about 125 met on a special train at Hot Springs in which they were carried to Arkansas City. Awaiting them was the steamboat *Tollinger*, a sternwheeler, which they boarded for a trip down the Mississippi River through the cut-offs at the famous Greenville Bends. The group arrived at Arkansas City a little after noon. Luncheon was served almost immediately on a quarter boat attached to the *Tollinger*. By this time, with additions at Arkansas City, the group had been increased to about 150.

HOT SPRINGS IN APRIL
Foliage in National Park Overlooking the Headquarters of the Spring Meeting

EXCURSION TO BAUXITE MINE
Scene near Entrance to Underground Workings—Photograph taken Saturday, April 25

FRIDAY EXCURSION THROUGH MISSISSIPPI RIVER CUT-OFFS ACROSS GREENVILLE BENDS
Party Disembarks near Lake City, Ark., After Completing River Trip

Fortunately for those who wished to see a demonstration of river hydraulics, the Mississippi was at a high stage, the Ohio River flood having just reached its crest at Greenville. About 1,250,000 cu ft per sec were flowing. As the boat proceeded down the river toward Lake Village, Ark., its destination, engineers who were in charge of the work in connection with the cut-offs explained the methods they had used, the difficulties they had encountered, and the effectiveness of the completed work to "straighten" the river at these points. Where formerly it was necessary to travel 40 miles to get through the Greenville Bends by water, it is now necessary to go only ten miles, a saving of 30 miles in distance and many hours in time.

Arriving at the dock nearest the Lake Village railroad station, the party became the temporary guests of members of the Lake Village Chamber of Commerce and their families and were transported in private cars to the station, a distance of about five miles. There the special train was waiting to make the return journey to Hot Springs.

Despite the fact that the sky was somewhat overclouded during most of the day, those who made the trip had an excellent view of the cut-offs, and for many who had heard so often of high water in the Mississippi, but had never seen it, there was the spectacle of trees along the banks at Lake Village submerged to the depth of their lower branches.

TRIP TO BAUXITE MINE

Many members found it necessary to leave for home on Thursday or Friday, but others arranged their affairs so that they could stay over until Saturday to visit a bauxite mine located about an hour's journey from Hot Springs. The party left Hot Springs at about nine on Saturday morning, returning in the afternoon. Snapshots of this and several other notable features of the Spring Meeting, furnished by courtesy of C. A. Mead, M. Am. Soc. C.E., are reproduced herewith.

Thus terminated a successful meeting, where those from the northern states were able to gain a month on summer weather and summer scenery, while others from Arkansas and the nearby southern states looked askance at top coats and overcoats, which proved to be wholly unnecessary equipment under the warm southern sun. Many who for the first time had opportunity to visit the oldest of the national parks can testify to its attractiveness. The Society is greatly indebted to the committees through whose efforts the arrangements were so successfully carried out.

Problems of Juniors Discussed at Ithaca Regional Meeting

ON MAY 9, 1936, a joint regional conference of Local Sections and Student Chapters was held at Cornell University, Ithaca, N.Y. The Buffalo, Rochester, Lehigh Valley, Syracuse, and Ithaca Sections were represented, and in addition the Albany Society of Engineers. Representatives of four Student Chapters were also present. A full account of the joint open session and the afternoon session of the Student Chapter representatives will be found elsewhere in this issue under the title "Regional Student Conferences Held."

The afternoon conference of Local Section representatives was presided over by S. C. Hollister, M. Am. Soc. C.E., director of the school of engineering, Cornell University. The discussion opened on the question of how assistance may be given to the Junior so as to better his relations with the practical engineer. That he be given something to do with his elders is the major thing, and this can be done to better advantage in the Local Section than in a Junior organization. The Junior should be encouraged to attend the Local Section meetings. The Junior is not reticent. He usually expresses his point of view and should be put on committees with the senior members.

Secretary Seabury pointed out that there has been general cooperation between the older and younger men and that the Society has appointed contact men. On several occasions the Society has sponsored a gathering of the younger men and has had older men meet with them. By an effort on the part of both, the Junior's contact with the Society can be made a happy one.

W. A. Hazard, M. Am. Soc. C.E., president of the Lehigh Valley Section, asked what becomes of the student after he gets out of school. The students to whom the Section makes its student awards of Junior membership usually stay in the Society one year and then drop out.

A. P. Skaer, M. Am. Soc. C.E., president of the Buffalo Section, stated that his Section treats the Junior the same as a corporate member and encourages the younger engineer to take part in the discussions of the Section. He declared that the older members should make an effort to help the younger men get a start.

D. W. Mead, President of the Society, pointed out that the organization of the Student Chapters has had a marked effect in increasing Junior membership. He stated that he favored a code of ethics that would be broad enough for everyone and that he believed in preaching ideals to the young engineer, in this manner keeping him away from things which would have a bad effect on his future career.

Warren C. Taylor, M. Am. Soc. C.E., of Union College, suggested that the Society prepare a booklet to help the student in engineering and to enlist his interest.

S. C. Hollister, M. Am. Soc. C.E., of Cornell University, emphasized the desirability of continuity between membership in the Student Chapter and Junior membership in the Society, and declared that the problem divides itself into (1) getting a large number of students into the Junior grade, and (2) planning interesting Junior activities in the Section, thereby maintaining the Junior's interest in the Society.

The following resolutions were adopted following the discussion:

"It is the sense of this conference

"1. That a grade of Student Member be established to which juniors and seniors in Student Chapters be eligible and for which the dues shall be $3.00 annually.

"2. That a member of a Student Chapter in an accredited college of civil engineering upon graduation be automatically created a Junior Member of the Society without initiation fee, and that yearly dues be increased each year after graduation, to those now prescribed for Juniors; further, that initiation fees of such members be collected only upon election to corporate membership.

"3. That the Local Sections place their Junior members on each of the standing committees, and make them special assistants to its officers as far as they are available.

"4. That the Local Sections appoint standing committees on engineering salaries, engineering registration, and engineering reemployment."

Early Presidents of the Society

In the widespread membership of the Society there must be many individuals who have known personally some of these early leaders, and others who have access to photographs or other interesting information in connection with their major works. Such persons are earnestly requested to assist in preparing this series of biographies by communicating with Society Headquarters. The subjects of the next three articles will be Alfred Wingate Craven, Horatio Allen, and Julius Walker Adams.

III. William Jarvis McAlpine, 1812–1890
President of the Society, 1868–1869

William Jarvis McAlpine was born to the profession, his father being a millwright and mechanical engineer. McAlpine senior took every occasion to direct his son's interest into the same channels, taking him even when a young boy to visit the mills and canal works he was building, and giving him personal instruction in the art.

William Jarvis McAlpine, Third President of the Society

The younger McAlpine made his first important contribution to the engineering profession when but 21 years of age. He was at that time a resident engineer on the Chenango Canal, under John B. Jervis (later Hon. M. Am. Soc. C.E.). The question of adequate water supply for the canal had arisen, and Jervis assigned him the duty of gaging the rainfall and runoff of the Eaton and Madison Brook valleys, in which reservoirs were to be built. McAlpine's investigation was complete, and his report, still of recognized authority, furnished the basis of most of the later work in this important branch of hydrology. In 1875, Jervis wrote that the ratios of rainfall to runoff determined by McAlpine had been proved correct by 40 years of operation of the reservoirs for which his study had been made.

McAlpine followed Jervis to the Erie Canal, and succeeded him as chief engineer of the eastern division (Little Falls to Albany) in 1836. The importance of the Erie Canal in promoting the development not only of New York State but of the entire Middle West need scarcely be mentioned, but a brief explanation of the enlargement is perhaps of interest. As completed in 1825, the canal had a draft of about 4 ft, and was about 40 ft in width at the surface and 28 at the bottom; the locks, 90 by 12 ft in plan, accommodated boats of about 70-ton capacity. The enlargement provided for double locks of increased capacity, and enlargement and some relocation of the channel itself. This work continued, with a few interruptions, until about the time of the Civil War, when the canal was—at least nominally—7 ft deep, 55.5 ft wide at the bottom and 70 at the surface, and equipped with locks 100 by 18 ft in plan, accommodating boats carrying 240 tons of freight.

McAlpine remained with the canal until 1845, when he left to become assistant engineer—and shortly thereafter chief engineer—in charge of constructing a granite drydock at the New York Navy Yard. The dock is still in service after 85 years—a testimony to a man who built on sure foundations, for the problem of providing adequate bearing for this structure was one of the most difficult foundation problems of the 1850's. The dock site was underlain with an almost impalpable quicksand and small veins of coarse sand through which flowed springs of fresh water. In all, 41 such springs were encountered in the course of excavating the pit. One of them, diverted from its first location by the driving of piles, undermined and burst through a nearby bed of concrete 2 ft thick. Another, accidentally closed by freezing, forced up some 1,200 sq ft of the foundations.

The dock chamber is 350 ft long and 68 ft in minimum width, with a depth of 26 ft over the miter sills at high tide. These dimensions permitted the docking of the then largest man-of-war in the Navy, if not in the world—the *Pennsylvania*.

The heavy masonry of the dock rests on more than 6,500 bearing piles averaging about 33 ft in length, and 1,700 tongue-and-groove sheeting piles completely surrounding the area. For the most part, they were driven by one- or two-ton hammers hoisted to a height of 30 ft—chiefly by steam power, but in some cases by men working with a crank or on treadwheels, or by horses. However, in the latter part of the work a Nasmyth steam piler was brought from England and put into service. "The novel principle on which this machine worked, consisted in very rapid short blows with a heavy hammer hoisted by the stroke of the engine with each revolution." It is reported that the weak construction of many of its parts was not adapted to such hard driving, and "during the three months it was on the work it was never in sufficient repair to perform one day's full service." (*Naval Drydocks of the United States*, Charles B. Stuart, 1852).

In addition to his work on the foundations and masonry, McAlpine designed the steam engine and pumps required for operation, and the turning gates—the largest iron gates of the time.

Accurate records of penetration, number of blows, and so forth were kept for each pile, and from them McAlpine developed one of the first formulas for the bearing value of piles. A signal honor was conferred upon him in 1868 for this and other work of a similar nature when the Institution of Civil Engineers (London), of which he was the first, and for a long time the only, American member, conferred upon him the Telford medal for a paper on the supporting power of piles.

In 1851 the City of Chicago (population 35,000) engaged McAlpine to design and construct the first municipal water works. The city fathers instructed him to provide for a population of 100,000—their estimate for the year 1865, which proved quite conservative. Accordingly, he designed pumps and reservoirs to supply 3,000,000 gal (imperial) per day, with a distribution system covering about 700 acres. His estimated total cost was $318,000.

The principal features of the project were an intake crib in Lake Michigan, about 600 ft from the shore; a 30-in. diameter wrought-iron intake pipe extending thence to the pump well; a Cornish pumping engine similar to the one he had designed for the Brooklyn dry dock; a reservoir tank to give a head of 60 ft and permit intermittent operation of the pumps; and distributing pipes.

The engine house was on the shore of the lake, near Chicago Avenue and Sand Street, and the reservoir was at the present site of the Chicago Avenue station, Chicago Avenue and Lincoln Parkway. At the latter location an old water tower, no longer in use, is still preserved as a landmark; it dates, however, from a later time and was not a part of McAlpine's work. McAlpine's reservoir consisted of a boiler-iron tank, 43 ft in diameter, surmounting a masonry building whose foundations were inverted arches of brick.

The third bridge to be built in this country by pneumatic caisson methods was the drawbridge constructed in 1860 across the Harlem River at Third Avenue, New York. (The present structure at that site dates from about 1897.) McAlpine's caisson consisted of a number of cast-iron cylinders, 6 ft in diameter and 9 ft in length, provided with flanges on the inside by which they were bolted together. The air lock was bolted to the top of the column.

In operation, this caisson was lowered by jerks, rather than steadily. When the column had been entirely cleared at the bottom, the workmen would ascend into the air lock, where atmospheric pressure would be gradually restored. Then, when they had left the lock, men were stationed at guy ropes and a cock was opened, allowing the air in the caisson to escape quickly. The weight was thus suddenly restored to the caisson "with an effect similar to a blow," while, at the same time, the rapid inrush of water at the bottom caused a complete scouring of the material at the rim. The amount of settling in one operation frequently amounted to 10 or 12 ft. When the column stopped it was recharged with air, and the process repeated.

It is believed that the Third Avenue Bridge is the first example of the now common practice of belling out the lower end of the column into the frustum of a cone, to provide greater bearing area. To accomplish this, wooden sheet piles were driven under the periphery of the caisson, outward and downward, the underlying material was excavated, and the space was filled with concrete.

McAlpine was perhaps the first American engineer to be consulted on an important European project. In 1870 he was invited by the Danube Navigation Company to examine and report upon the improvement of the Rapids of the Danube, which had been under discussion for many years by the most distinguished engineers of Austria and Hungary. The adopted plans followed the general line of his recommendations, and at the time of his death in 1890 the company in charge of the work was still planning to call him to take charge as soon as their arrangements were completed.

In 1881 he became chief engineer of the Arcade Railway, "a most luxurious project for an underground rapid transit road in the City of New York, providing a second street under Broadway with sidewalks, giving access to underground shop fronts, with four tracks between them for local and express trains. This plan was defeated by the opposition of property owners who resented the interference with their vaults under the surface sidewalks, and a second plan confining the works to the space under the carriageway was stopped by defects of its charter." McAlpine, however, never lost his interest in the establishment of a subway, and gave much study to all details of the work.

The City of New York will remember McAlpine as the engineer of the department of parks who in 1879 and 1880 directed the construction of Riverside Drive. The state will recall his public service in the 1850's as state engineer and later as railroad commissioner, and his later work as a private engineer in preparing the seven acres of difficult foundations for the State House at Albany.

He designed and constructed the New Bedford water works in 1865, and at various other times served either as consultant or designer on water works at Albany, Norfolk, Montreal, Toronto, and at least seven other important cities. He built some of the early wharf structures at Galveston, and was a consultant for four years on Captain Eads' proposed ship railway across the Isthmus of Tehuantepec. At various times, also, he was chief engineer of the Erie Railway and of the Galena and Chicago (now part of the Chicago and Northwestern) Railroad, and vice-president of the Ohio and Mississippi Railroad.

But space will permit only a passing mention of these engagements, for McAlpine made another sort of contribution to the profession to which attention must be given—a contribution that will be remembered after the last of the physical structures he erected shall have served its turn and been replaced. This was his work in molding American engineers into a true profession.

He recognized two distinct functions of a national organization of engineers—one, the dissemination of technical knowledge, and the other, the promotion of a professional attitude. "There is no profession," he said in his inaugural address, "which has not a similar association, and until we have established our Society upon a stable basis we shall not be regarded by the public as having really attained a professional character. Those engineers who by long study and practice are entitled to rank themselves in the profession have (heretofore) had but little advantage over those who have assumed the name without much of either, because there has been no standard by which the public could judge of their qualification."

"The true engineer loves and is devoted to his profession. He believes it to be the noblest of them all, giving scope to higher and deeper thoughts, and wider range for the intellect, but especially to those thoughts which are immediately beneficial to mankind."

He was an earnest advocate of the duty of every engineer to give his fellows the advantage of his observations and experiences. "I fear," he said, "that our experienced engineers, especially those of the old school, become indolent in recording their operations as they grow older. I am not certain but that we ought to require from each member the annual contribution of a paper, description, or drawing of some work of interest."

A PUBLIC CELEBRATION ACCOMPANIED THE LAYING OF THE COPING STONE AT THE BROOKLYN DRY DOCK ON JULY 4, 1849
Reproduced from an Original Rendering Commemorating the Event

McAlpine heeded his own precepts, and wrote careful, clear accounts of almost every project on which he was engaged. The viewpoint he adopted in his writing, as illustrated by the concluding paragraph of one of his articles, is worthy of consideration by anyone preparing a technical paper. Describing repairs on an earth dam, he stated: "The foregoing account has been written out with more detail than would be necessary for the information of experienced hydraulic engineers. It is intended chiefly to interest the younger members of the profession, and particularly to enable the author to introduce a few of his practical experiences. In preparing this paper he has made no effort at elaborate writing, in the hope that it will induce many young members to submit their experiences to the Society, and thus instruct themselves as well as their associates."

During McAlpine's incumbency, the first Annual Convention of the Society was held—in New York, June 16, 1869.

His interest in the younger members of the profession he retained throughout his life. Late in his career he wrote: "My most earnest wishes now are to maintain the dignity of the profession, and to obtain for it the respect of the community. Beyond the necessity of providing a moderate maintenance for my family, my chief object is to lay before the young engineers the experience of a long professional life of practice and study. Some of you and all of my older friends know that whatever information on any branch of the profession I have, is as much at their service as if it were their own; and that nothing gives me more pleasure than to be able to contribute to the success of others, and especially of the young engineer. . . . As a motto to engrave upon your professional shield, I give you these three words—'Integrity, Industry, Enthusiasm.' "

[Much of the information in this biography has been obtained from McAlpine's own writings. His library, including an almost complete collection of drawings of the projects on which he was engaged, was presented to the Society in 1873, and is a valuable source of historical data.]

Fourth Annual Report of P.E.C.U.

IN THE FOUR-YEAR period ending October 1, 1935, the Professional Engineers' Committee on Unemployment found positions for a total of 7,864 engineers in the New York metropolitan area. The four-year figure represents 72 per cent of the registrations during the same period; in the last year alone, however, there were 614 more placements than registrations, the figures being respectively 2,353 and 1,739. By contrast, in 1934 there had been some 3,100 placements and more than 4,000 registrations.

During 1935, says the fourth annual report of the committee, P.E.C.U. "continued to be the principal agency for placing engineering and supervisory personnel on emergency work programs in the metropolitan area. It has also continued to be the agency to which technical men have looked primarily for emergency assistance."

"While the work of placing engineers on emergency operations has decreased materially, the Works Progress Administration has asked the assistance of P.E.C.U. in confirming the qualifications of technical men to fill positions in industry and other lines of regular employment. Also P.E.C.U. has assisted the New York State Employment Service in the preparation of manuals for use in selecting personnel in the highway and other construction fields. The P.E.C.U. has also been active in endeavoring to establish appropriate rates of pay for engineers on WPA projects both in New York and New Jersey."

The employment picture for engineers has changed materially during the past year, owing to opportunities both in industry and in the more permanent governmental operations. However, the report points out that many engineers are still engaged on emergency work programs of uncertain tenure. "There is still a definite need, therefore, to continue P.E.C.U. for some time in the future."

"The work of P.E.C.U.," the report continues, "has been made possible only through voluntary contributions largely from members of the national engineering societies. Although the contributions have decreased each year, the necessity for funds has likewise fortunately diminished, and P.E.C.U. has been able to function effectively.... The balance on hand at the end of the year totaled $5,198.72, which is sufficient only to carry on for about four months at the present rate. There is need, therefore, for additional funds."

P.E.C.U. is a voluntary organization, initiated in October 1931 by George L. Lucas, M. Am. Soc. C.E., then president of the Metropolitan (New York, N.Y.) Section of the Society. The metropolitan sections of the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers were invited to join and promptly did so. The work is administered by an executive committee containing as members the presidents of the Metropolitan Sections of the Founder Societies. Of the $200,000 received to October 1, 1935, members of the American Society of Civil Engineers had contributed $64,000.

The members of the executive committee for 1936 are William R. Smith, chairman, and V. T. Boughton, Assoc. M. Am. Soc. C.E., and C. R. Beardsley, Clinton Bernard, and J. N. Landis. C. E. Beam, M. Am. Soc. C.E., is its executive secretary.

Juniors Active in Philadelphia Section

ON APRIL 15, 1936, the Juniors of the Philadelphia Section conducted for the first time a regular meeting of the Section, in this way demonstrating their interest and ability as a group. An account of the meeting, at which three interesting papers were presented by Juniors, appears in this issue in the "News of Local Sections" department.

This young organization was conceived by Scott B. Lilly, M. Am. Soc. C.E. At a meeting held December 6, 1935, ten Juniors were present. After plans and activities were discussed, a chairman was elected, and those present were constituted a Junior Committee. Upon investigation it was found that many of the Juniors were members of the Junior Engineers Club of Philadelphia. As this is a live-wire organization of young men, the committee decided that the Juniors could use their experience in the classes and meetings of that group and restrict their present activities to the April "Junior Meeting" previously referred to.

The primary object of the group is to have the Juniors become better acquainted with one another and with the members of the Section. It is felt that the success of the plan for this year warrants its continuance in similar form for the next year, when it is hoped that more Juniors will become interested and active in the work of planning and presenting the meeting.

The Junior Committee is composed of the following: A. H. Wagner, chairman, S. T. Carpenter, H. J. Engel, L. A. Huber, J. B. Letherbury, P. MacMurray, R. R. Robinson, J. G. Smith, Jr., M. M. Sommer, and W. G. Stevens, Jr., all Juniors of the Society. The foregoing information regarding activities of the Juniors was furnished by Mr. Wagner, chairman of the committee.

Student Chapter Conducts Radio Program

A RADIO PROGRAM by members of the Oregon State Agricultural College Student Chapter was broadcast by KOAC, Corvallis, on April 27, as one of a series by the student branches of all the national engineering societies. KOAC is the state-owned radio station operated by the General Extension Division of the Oregon State System of Higher Education. "It is the purpose of the boys in these programs to present engineering and its relationship to the social and economic life of the community so that the average citizen will have a better understanding of the work of the engineer," writes F. Merryfield, the faculty adviser.

Mr. Merryfield goes on to describe the method worked out by the Chapter for conducting its regular meetings: "About a week prior to each meeting, several boys are asked to give short talks on some phase of civil engineering with which they are familiar. These talks are not to exceed ten minutes in length. Several of the boys have used articles from CIVIL ENGINEERING as the basis for their talks, and to date our meetings have been of exceptional interest, well put on, and well organized. In addition, it was stressed that the meeting should not be longer than one hour, and that it should start on time. The result has been that our average attendance has increased about 30 per cent, so that now about 80 per cent of our membership attends regularly."

Regional Student Conferences Held

Spring Gatherings at Various Eastern Institutions Are Well Attended

For many years after the first Student Chapter was founded in 1920, these units of the Society pursued their individual way with only casual contact with other Chapters. During the last six or seven years, however, there have been occasional conferences of Chapter representatives at the time of Society meetings in the spring and fall, at which Chapter problems have been discussed and ideas exchanged. To the Philadelphia Section should go the credit for the establishment of a different type of conference, regional in character, at which neighboring Chapters get together year after year to conduct what is, in effect, almost a miniature of a Society meeting. The Society's Committee on Student Chapters has been steadily promoting the formation of more regional conferences, and the following account of six meetings of this type indicates the extent to which the Chapters are taking hold of this very creditable idea. To the student officers should go full credit for planning and conducting these stimulating sessions.

DURING THE MONTHS of March, April, and May, there were held six conferences of representatives from Student Chapters resident in definite regions. During the same period a Student Chapter Conference was held in connection with the Hot Springs, Ark., meeting of the Society. The latter type of conference is scheduled whenever there is a suitable meeting of the Society as a whole; the former belongs in a geographical region where the Chapters at the various colleges take turns entertaining the other members of the group.

UNIVERSITY OF ALABAMA—MARCH 16–17

The Student Chapter at the University of Alabama was host to representatives from the Chapters at Tulane University, the University of Mississippi, and the Alabama Polytechnic Institute—a total of 47 students, together with five faculty members, six members of the Alabama Local Section, and Director F. H. McDonald of District No. 10. Inspired by the conference at Birmingham in connection with the Fall Meeting of the Society in October 1935, the officers of the University of Alabama Chapter, President Nathan R. Hower and Secretary George Sunda, conceived the plan for the conference and carried it out. The dates were selected so as to include the annual Engineers' Day at the University of Alabama, held every March 17 in honor of St. Patrick, frequently accepted as the patron saint of engineers.

The first session on Monday, March 16, was opened by N. R. Hower, president of the Student Chapter at the University of Alabama, who presented Dean George Jacob Davis, Jr., of the school of engineering, formerly Faculty Adviser to the Chapter. Dean Davis, in welcoming the representatives, reviewed student activities of thirty years ago, pointed out that engineering society programs in those days seldom took account of the student's limited ability to understand highly technical matters, and contrasted these conditions with present-day student activities sponsored by the Society as a definite introduction to the profession.

The conference discussions first centered about the organization of a permanent regional conference. Plans were discussed for the setting up of a permanent standing committee on meetings, and a statement of principles to govern the programs of each year was suggested.

E. M. Lee, a senior from the Alabama Polytechnic Institute, read a paper on "Consolidation of Engineering Professions," followed by a talk by Mr. Youngs, former member of the Student Chapter of the University of Alabama, describing his work in the aerial mapping division of the Tennessee Valley Authority. Other papers were by Mr. Woodruff of the University of Alabama Chapter, describing his experiences with the U. S. Coast and Geodetic Survey, and by Mr. Martiny of the same institution, whose subject was "The Economic Aspects of the Florida Canal."

In the afternoon the representatives from Tulane University presented an illustrated lecture on "The Construction of the Mississippi River Bridge at New Orleans." Dean Lee Bidgood of the school of commerce and business administration, University of Alabama, spoke on "The Part Played by the Engineer in the Development of the South," and then a motion picture of construction methods used at Norris Dam was presented by J. R. Thrasher, of the University of Alabama. In discussion Dean Hargis, Faculty Adviser of the Chapter at the University of Mississippi, recounted his own experiences at Norris Dam during its construction. In closing the session, Dean Davis of the University of Alabama, and Dean Callan of Alabama Polytechnic Institute, spoke briefly, the latter on the progress of the present program of mapping the State of Alabama.

The evening session consisted of a joint dinner with the Alabama Local Section. The master of ceremonies was Prof. D. A. du Plantier, who presented the president and other officers of the Alabama Section. The principal speaker of the evening was A. C. Polk, M. Am. Soc. C.E., chief of the industrial water development project now under way in the Birmingham area. He stressed his experiences with young engineers. The dinner speeches were concluded with an address by Frederick H. McDonald, Director from District No. 10, who described the attitude of the national Society toward student and Junior engineers.

On the following day the visitors took part in the celebration of St. Pat's Day, which is Engineers' Day for the University. These widely publicized activities consisted of a pageant, exhibits in the laboratories, a banquet at which a cup was awarded to the outstanding senior engineer, and finally the St. Pat's Ball in the college gymnasium. Among the exhibits by the civil engineers were a model of a steel truss railway bridge and a section of slab, beam, and tile construction of a concrete floor.

The officers of the University of Alabama Chapter, who were responsible for the conference, stated that they considered it successful as a first venture. They had anticipated that there would be considerable room for improvement. For example, they think there should be a much greater participation by the representatives from other Chapters and less of a show put on by the Chapter which acts as host. The principle of the conference is thought sound, and it should be considered as definitely established, ready to be carried on with constant improvements. It was recommended that the date for the next conference be selected so as to avoid quarterly or mid-semester examinations, which had prevented the sending of representatives from the Chapters at the University of Tennessee and Vanderbilt University. The Chapter officers also expressed their deep appreciation for the cooperation of the officers of the Alabama Section.

Data for this report were furnished by Secretary George Sunda of the Alabama University Student Chapter.

MODEL OF A STEEL-TRUSS RAILROAD BRIDGE
Laid Out and Built by N. R. Hower and George Sunda, Members of the University of Alabama Student Chapter

VIRGINIA POLYTECHNIC INSTITUTE—APRIL 3–4

The Student Chapters in the State of Virginia continued their series of regional conferences begun last year by staging a two-day

session at Virginia Polytechnic Institute. Representatives from the Chapters were present as follows:

Virginia Polytechnic Institute	50
Virginia Military Institute	45
University of Virginia	12

The three Faculty Advisers and two of the Contact Members were present; also Vice-President Sawyer of Zone II; P. A. Rice, Secretary of the Virginia Section; T. R. Edmonston of George Washington University; Prof. F. J. Sette of Washington, D.C.; and Walter E. Jessup, Field Secretary of the Society.

The purpose of the conference was expressed by J. C. Key, vice-president of the Virginia Polytechnic Institute Chapter, as follows: "At this second annual joint meeting of Student Chapters we have attempted to carry on the plan conceived at Virginia Military Institute last year, 'to establish closer bond between Student Chapters and the parent Society and to permit an interchange of ideas between represented colleges.' There should exist between engineers a universal bond of friendship. One of the principal objectives of this convention is for us to make contact with student engineers from other colleges and with the older engineers who have become outstanding in their profession."

Dean Earle B. Norris, of the School of Engineering at Virginia Polytechnic Institute, welcomed the representatives at the first session on Friday afternoon. Field Secretary Jessup spoke on the early history of the Society and the growth and usefulness of its Student Chapters. Then Professor Sette, Associate Professor of Civil Engineering, who has been on a leave of absence for a year in Washington as director of a division of the Resettlement Program, described some phases of the marginal land problems which faced the Resettlement Administration.

At an evening session A. P. Bursley, of the National Park Service, gave a paper illustrated with sound pictures on "Parks and Planning," in which he described the part played by engineers from the time a park site is selected until it is ready for the public.

On Saturday morning the sessions were resumed with a paper on "The Graduate Engineer Faces the World," by W. M. Johnson, consulting engineer of Lynchburg, Va., who graduated from Virginia Polytechnic Institute eight years ago. He sounded the warning that during the first few years of an engineer's career he is likely to have some dull or monotonous moments. Nevertheless he will surely find that all his experiences are stepping stones to higher positions.

Maj. C. J. Calrow, of the Virginia State Planning Board, spoke on "The Part of the Engineer in State and National Planning." The final speaker of the morning was R. J. Holden, Professor of Geology at Virginia Polytechnic Institute, who talked on "Dams and Reservoirs" and showed that a great many factors must be taken into account by the engineer in building a dam. The engineer has three great responsibilities—his duty toward the people who invest money in the project, protection of the lives of people that might be endangered by the failure of his dam, and his own reputation.

Saturday afternoon was devoted to papers by members of Student Chapters. The Virginia Polytechnic Institute program was under the direction of J. C. Key and consisted of the following papers: "Why Take Civil Engineering?" by L. T. Gatling; "Centrally Mixed Concrete," by R. L. Fletcher; and "Local Control Surveys," by J. L. Hammer.

The University of Virginia program consisted of the following papers: "The Development of Low-Heat Cement," by W. A. Townes; "Present Trend in Highway Engineering as a Contribution to Highway Safety," by R. G. Copper; "The Program of the Engineers' Council for Professional Development," by J. M. Cowgill; and "The Development of Arc Welding in Engineering Construction," by W. Starke.

The final program was presented by the Virginia Military Institute Chapter under the direction of W. H. Oglesby. The papers were "The Southern Pacific in Mexico," by R. B. Douglas; "Hobbies and Their Importance," by A. T. White; "Our Mounting Highway Toll," by J. C. Curley; "Colonel W. M. Patton—a Biography," by W. T. Rison; and "Tangier Island and Its People," by A. J. Bott.

The University of Virginia Chapter invited the conference to meet with it next year and the invitation was accepted.

The final event of the two-day conference was a banquet on Saturday night, presided over by Professor Sette.

The Conference was conducted by J. D. Key, vice-president of the Virginia Polytechnic Institute Chapter. Stuart Shumate, president of the Chapter, to whom much credit is due for the success of the meeting, was confined to the infirmary and unable to take part in the sessions. However, he later said: "I feel that something more than the stated objective of this convention was accomplished. Not only was a closer bond established between the Student Chapters, but a better understanding was brought about between the schools represented. Student engineers were given an opportunity to meet some of the older members of the Society. Meeting this fine group of men made them realize that the ideals of the Society and of our profession are high, and that when these young men begin their work they must be prepared to assume and to carry on a large responsibility that will be entrusted to them by these older men."

Professor Hartman, Acting Head of the Department of Civil Engineering at Virginia Polytechnic Institute, concluded: "I feel that these student conferences are an excellent means of bringing the young engineers together and establishing a contact that could probably be made in no other way. Also, the faculty members of the different colleges are brought together under circumstances which tend to create valuable discussions from a teaching standpoint."

Data for this report were furnished by the officers of the Virginia Polytechnic Institute Chapter.

Pennsylvania Military College—April 20

Pennsylvania Military College was host to nine other Chapters in the Philadelphia area on April 20, at the second annual all-day student convention sponsored by the Philadelphia Section of the Society. Representatives were present from Chapters as follows:

University of Delaware	35
Pennsylvania Military College	19
Villanova College	15
Drexel Institute	14
Lafayette College	13
Lehigh University	9
University of Pennsylvania	8
Bucknell University	7
Swarthmore College	7
Pennsylvania State College	5
Total	132

In addition, there were present about a dozen Faculty Advisers and Contact Members, the president and secretary of the Philadelphia Section, and other members of the Society.

The conference proceeded under the direction of Edward Fay, Jr., president of the Pennsylvania Military College Chapter. Col. Frank K. Hyatt, president of the college, welcomed the representatives, told them that the college was theirs for the day, and urged them to analyze their approach to the profession objectively as well as subjectively so as to see where they are heading and make sure that no opportunities are lost on the way. The response was by Allen P. Richmond, Jr., Assistant to the Secretary of the Society.

Four technical papers were presented in the morning and four in the afternoon. The complete list is as follows: "New Developments in Concrete Columns," by Lawrence F. Shevland, Villanova College; "Accurate Testing of Large Reinforced Concrete Slabs with Inexpensive Apparatus," by R. A. Haber, University of Delaware; "Sheet Metal Construction of Airplanes," by Robert S. Schairer, Swarthmore College; "Girders with Inclined Stiffeners," by William F. Lotz, Jr., Lehigh University; "The Flood Problem in the Schuylkill Valley," by Anthony J. Maiale, Drexel Institute; "Experiments on Wood as a Structural Material," by Lawrence P. Williams, Pennsylvania State College; "The Warner Brothers Central-Mix Concrete Plant," by C. G. Mott, University of Pennsylvania; and "Underpinning the New York Sky Line," by Howard Clark, Bucknell University.

At noon the College and the Cadet Corps entertained the representatives at luncheon in the college mess hall while lively music was furnished by the student orchestra. The afternoon session was opened with selections by the Pennsylvania Military College Glee Club, and was concluded by a drill and review by the Cadet Corps. There was also opportunity to inspect the cadet quarters.

Award of the Philadelphia Section prize for the best paper was made as a result of balloting by the audience. The prize was awarded to R. A. Haber, University of Delaware, and was presented by Charles S. Shaughnessy, president of the Philadelphia Section.

During the day a meeting of the executive committee of the conference was held at which the invitation of Villanova College was accepted to hold the conference there in 1937, and that of the University of Delaware to meet with it in 1938.

Suggestions for Judging Which Paper is Presented Best

The Philadelphia Section of the A.S.C.E. is to give a prize of Twenty Dollars to the man on today's program whose presentation is judged to be best, as determined by the secret ballot of this audience.

In order that there may be uniformity in the judging, the following suggestions are made:

	Excellent	*Good*	*Fair*
1. Bearing—Impression made on audience... Is he natural or stilted? Has he annoying mannerisms that attract the attention of the audience? Does he hold his audience?	25	15	5
2. Diction—Pronunciation and enunciation.. Does he pronounce correctly? Does he speak in a clear voice, sufficiently loud to carry to all the audience?	25	15	5
3. Method of delivery and its effectiveness... Was it read, spoken from memory or delivered in a conversational, natural way? Has he gotten his own personality "over" in a way to add interest to his theme? Have various points been clarified by illustrations, slides, blackboard sketches or models?	35	25	15
4 Timing (Limit 15 minutes)............ Is the paper presented within the allotted time, without noticeable rushing through it at any part?	15	10	5
5 Difficulties of technical presentation and success of the speaker in meeting them.	50	30	20
	150	95	50

METHOD OF SCORING USED AT PENNSYLVANIA MILITARY COLLEGE CONFERENCE

Under This Method, First Developed by the Philadelphia Section, Student Papers Are Judged by Vote of the Audience

Several features of this conference deserve special comment. The Philadelphia Section has sponsored a series of student conferences for many years. Prior to 1935 the conference occupied only a half-day, with an evening session in Philadelphia at the Engineers Club as guests of the Philadelphia Section. Beginning last year, the present all-day type of conference was adopted, and its immediate success has insured its continuance. No evening session is held, as it is felt that a whole day of varied activities is sufficient. Lighter forms of entertainment are introduced during the day.

As at other student conferences, the emphasis is on planning and management by the student officers. Also, the sessions are held on a week-day, which has guaranteed better attendance by avoiding week-end diversions and by permitting the student representatives to be excused from regular classes for this purpose.

The data for this report were furnished by Cadet Edward Fay, Jr., president of the Pennsylvania Military College Chapter.

METROPOLITAN CONFERENCE—APRIL 25

A full day of interesting sessions and inspection trips at three separate institutions marked the first all-day conference of Metropolitan Student Chapters of the Society. The sessions were held on Saturday, April 25, 1936, and were attended by representatives from the following Chapters:

College of the City of New York	25
Newark College of Engineering	25
Cooper Union	8
Columbia University	9
New York University	7
Manhattan College	7
Rutgers University	8
Total	89

Also present were Faculty Advisers, Contact Members, and others, making a total attendance of more than a hundred. The Chapters of Columbia University, City College, and Manhattan were hosts at the three sessions.

The activities of the day were opened at Columbia University by Walter Gray, chairman of the conference. Dean Barker of the school of engineering at Columbia then gave the formal welcome and pointed out some of the mile-posts on the road to professional recognition, to be traveled by all engineers in the course of their careers.

The feature of the Metropolitan Spring Conference has always been the presentation of papers by students. In previous years the papers had been pre-judged and eliminated until only four were left, whose final presentation was judged by a committee of picked men from the engineering profession. At this year's conference, however, one paper was selected from each school to be presented. The following papers were given and then judged by popular vote: "The Solution of Statically Indeterminate Structures by Transmission Coefficients," by Abraham Patt, Cooper Union; "Wind Observations on the Empire State Building," by Walter Gray, College of the City of New York; "Debunking Structural Analysis," by David Williams, Columbia University; "Rockets as a Means of Transportation," by D. J. Prugh, Rutgers University; "Recent Advances in Metropolitan Sewage Treatment," by Francis J. Maher, Manhattan College; "Construction Features of the Mid-Town Tunnel," by John F. Curtin, New York University; and "Underground Construction," by Walter Gadkowski, Newark College of Engineering.

The first prize of $10 cash and $10 on account against the Junior membership initiation fee was won by John F. Curtin of New York University. The second prize of $10 was awarded to Walter Gadkowski of Newark College of Engineering.

The conference enjoyed a fine luncheon at John Jay Hall, Columbia, and dinner at the Hamilton Place Hotel. Between sessions and dinner gatherings, inspection trips to the laboratories at Columbia and at City College were conducted by students of these two Chapters.

Entertainment was supplied at the evening session at Manhattan College by the Manhattan and City College Chapters, who presented a dramatic skit and special vocal numbers. Members of the Manhattan Chapter wrote, directed, and staged a burlesque radio broadcast over Station WASCE, especially for the occasion.

President Robinson of the College of the City of New York, Dean Barker of Columbia, and Brother Leo, Dean of Engineering at Manhattan, commented upon the fine spirit and enthusiasm shown at the sessions and the value obtained from the social contacts as well as the educational benefits.

As at the other student conferences previously described, all indications point toward a permanent conference organization with steady improvement from year to year. Also, as at the other conferences, the credit for planning and working out the details goes to the students themselves. In the Metropolitan Conference all the ideas originated in the meetings of the executive committee and were carried out by subcommittees. No small amount of praise is due the officers and committee chairmen.

The data for this report were furnished by Orman P. Sloat, Newark College of Engineering, Secretary of the Metropolitan Conference.

CONFERENCE OF MARYLAND AND DISTRICT OF COLUMBIA STUDENT CHAPTERS—MAY 7

The first annual regional conference of the Maryland and District of Columbia Student Chapters of the American Society of Civil Engineers was held in Washington, D.C., Thursday, May 7, 1936. At this conference George Washington University acted as host to the Student Chapters of Johns Hopkins University, University of Maryland, Catholic University of America, Virginia Polytechnic Institute, University of Virginia, and Virginia Military

Institute. The principal speakers and guests of honor on this occasion were D. W. Mead, President of the Society, and George T. Seabury, its Secretary.

The aims of these gatherings as expressed in the constitution of the conference are to create a greater interest in the Society; to foster desirable relations with the parent society; to promote good fellowship among the Student Chapters; and to further the knowledge of the standards and ethics of the engineering profession.

In February, prior to the conference, representatives from the Student Chapters of the universities in this area had met to discuss the establishment of an annual conference program and to select the place of the first meeting. The George Washington University Chapter was designated as host for the first conference, with T. Ritchie Edmonston as chairman. The Johns Hopkins University Chapter was delegated to draft a constitution. Hunter W. Hanly, M. Am. Soc. C.E., now chairman of the Society's Committee on Student Chapters, advised and collaborated with this committee.

Pursuant to these plans, the morning session of the conference in Washington was called to order by Thomas T. Adams, president of the George Washington University Chapter. John R. Lapham, Assoc. M. Am. Soc. C.E., dean of the school of engineering at that institution, discussed the value of organization, showed that in itself it could be good or bad, and declared that the important things are the ideals and purposes of the organization.

The various groups in attendance were then introduced to the conference. A very large attendance was noted.

Dr. Mead pointed out the importance of acquaintanceship among engineers, and outlined a philosophy for engineering students, stressing the value of high ideals and attitudes in their chosen profession. He emphasized the interest which the Society has demonstrated in the Student Chapters. He suggested holding more joint meetings of Local Sections and Student Chapters as a means of drawing the older and the younger men closer together.

Membership in the national societies of a particular profession as a means of forming acquaintanceships which will lead not only to jobs but also to general professional advancement, was advocated by Secretary Seabury. He also pointed out the importance of health and enthusiasm for work as factors in engineering success.

The constitution of the conference was presented and adopted. (Mimeographed copies are available to all who desire them on request to Society Headquarters.)

After motion pictures showing the construction of the Mount Vernon Memorial Highway, the conference adjourned for luncheon.

The afternoon program consisted of inspection trips. The entire group first viewed an exhibit of building materials in the Procurement Division of the Treasury Department, in the newly constructed Federal Warehouse Building, which is in itself an object of interest to engineers. The exhibit is furnished by the leading manufacturers of building materials throughout the country. W. E. Reynolds, M. Am. Soc. C.E., Assistant Director of the Procurement Division, Treasury Department, explained in detail the functions of the various federal engineering departments in expending the money appropriated for public works.

The inspecting party then divided itself into two groups. Group A visited the U. S. Navy Yard, where they inspected the making of shells, gun mountings, and special castings. Opportunity was given to see the rifling and designing of gun barrels. An interesting feature of this trip was a demonstration of the extreme accuracy and precision necessary in the operation of the various types of special machinery. This group was then conducted through the Supreme Court Building, which is of interest to students of structural engineering.

Group B inspected the District of Columbia sewage treatment plant at Blue Plains, D.C. This, perhaps the most modern of all sewage treatment plants, is designed as a partial combined system. It is planned to use the gas generated to supply heat to the various buildings. Group B then visited the new Archives Building, which is to house the national collection of original historical documents. Its structural design is unique, and it includes a complete air-conditioning plant.

Dinner was served at 6:30 p.m. in the Oak Room of Wesley Hall, with Prof. Norman B. Ames of George Washington University acting as toastmaster. In the opening address, delivered by Donald H. Sawyer, Vice-President of the Society from Zone II, young engineers were encouraged to be zealous in their efforts to continue the conferences each year, inasmuch as the contacts they will make as a result of such affairs will be invaluable to them in their future work.

Following this opening address, officers of participating Chapters were called upon for a few remarks. Each expressed his earnest desire to promote a greater interest in the Student Chapter activities for the good of the Society in the years to come. These officers were: T. Ritchie Edmonston, George Washington University, chairman of the Conference Committee; and the presidents of the following Chapters: Harry Page, Jr., Johns Hopkins University; Maurice J. Dufficy, Catholic University of America; R. E. Volland, University of Maryland; and T. T. Adams, George Washington University.

Many notable engineers, members of the Society, were present. Among those not previously mentioned were R. C. Marshall, Jr., president of the District of Columbia Section; and Clifford A. Betts; C. H. Birdseye; R. S. Buck; Roy W. Crum, Contact Member of the George Washington Chapter; Glen E. Edgerton, member of the Committee on Student Chapters; J. C. Hoyt; and Edwin F. Wendt, member of the Committee on Technical Procedure.

George O. Sanford, of the Bureau of Reclamation, entertained the group with a series of motion pictures on the construction of the Grand Coulee Dam and the placing of the steel pipe in the penstocks of Boulder Dam. He also exhibited one of the large rivets used in joining the sections of the pipe.

The principal address was by Dr. Mead, President of the Society, who warned against unethical practices in the engineering profession. He urged that the conferences be continued and kept alive, and that the young men about to start the practice of engineering begin to interest themselves at once in the problems that are going to confront them.

This report was prepared by Mr. Edmonston, chairman of the Conference Committee. Dean Lapham, commenting on the sessions afterwards, said: "This Conference has been a particular source of satisfaction . . . because its success is in no small measure due to the excellent work done by Mr. Edmonston in making the preparations and putting them through."

Cornell University—May 9

A joint regional conference of Local Sections and Student Chapters was held at Cornell University, Ithaca, N.Y., on Saturday, May 9, 1936. Representatives were present from the Student Chapters at Rensselaer, Union, Syracuse, and Cornell, and from the Buffalo, Rochester, Lehigh Valley, Syracuse, and Ithaca Sections of the Society, as well as from the Albany Society of Engineers. There were 90 present at the opening session.

This opening joint session at 10 a.m. in Franklin Hall was presided over by H. E. Snyder, M. Am. Soc. C.E., of Elmira, N.Y., president of the Ithaca Section. Having welcomed the group on behalf of the Ithaca Section, Mr. Snyder asked S. C. Hollister, M. Am. Soc. C.E., director of the school of civil engineering, Cornell University, to describe the purpose of the conference.

Dean Hollister said that the purpose of the conference was to discuss the problems of the member of the Student Chapter and the Junior of the Society, and to inquire into the reasons why more members of the Student chapters, upon graduation, do not take Junior membership, or taking it, fail to continue on into the corporate grades. This indicates a loss of interest and the conference would try to find out why it happens.

D. W. Mead, President of the Society, and an alumnus of Cornell, next addressed the meeting, pointing out to the students that acquaintanceship among engineers is important to the success of the young engineer, and that the national engineering society can be a very great help to the young man in making proper engineering contacts and in getting oriented in his work.

Secretary Seabury told about the other conferences that have been held and said that they were proving successful as further means of bringing the Society to its scattered membership and also in helping the Society to find out what it can do for its members.

In the afternoon the students and Local Section representatives met separately. A report of the Local Section session will be found elsewhere in this issue. The afternoon session of Student Chapter representatives was held in West Sibley Hall with Arthur F. Glasser, president of the Cornell Student Chapter, presiding. There were present representatives from the Chapters at Rensselaer, Syracuse, Union, and Cornell.

The subject of discussion was how to arouse student interest in the Society which will result in a greater number of Junior member-

ships and active participation afterwards by these Juniors in Society affairs. Discussion demonstrated that there appear to be three main reasons why student interest becomes lax and why individuals fail to take advantage of the many opportunities that are available to young engineers through the Society: (1) Pure indifference, (2) lack of close contact between Student Chapter and Local Section, and (3) ignorance of the true nature of the Society and of what it has to offer young members.

R. K. Palmer, of Rensselaer Polytechnic Institute, said that one means of arousing interest within the Chapter might be to devote more meetings to the discussion of professional problems which will face the young engineer rather than to concentrate solely on those of a purely technical nature.

Dr. Mead suggested that another way of bringing Chapter discussions more intimately to the members would be to include more papers on smaller, less spectacular works, closer to home and more frequently met with in the practice of every engineer, which would probably be more appreciated than programs devoted exclusively to major engineering projects.

The conference inquired about organizations of Juniors in which they might feel more free to talk and act than they do in Local Section meetings. In reply it was pointed out that in many localities there are not enough Juniors to warrant an organization of their own. Most Local Sections now make it a regular practice to place one or more Juniors on each Section committee to make them feel more thoroughly at home by actual participation in Section work. It is recommended that Junior organizations be formed whenever the desire is felt, to carry out their own particular projects, but under no circumstances should Juniors separate from the older men and thereby deny themselves the valuable contact with the older and more experienced members which ultimately will be their most prized return from Society membership.

Many of those present felt that it would be very helpful if there could be closer cooperation between Juniors in the Society and the members of Student Chapters. It was emphasized that students should retain complete control over their activities. But since Juniors are closer to the students as regards age and experience, they could have considerable influence in explaining the activities of the Society and in demonstrating the practical advantages of affiliation with it upon graduation.

Secretary Seabury enlarged upon this latter topic and told what the Society has done in the past and what it is now doing to make membership more attractive to young men.

In concluding the afternoon session of the Student Chapters, two resolutions were adopted unanimously. First it was urged that an amendment to the Society's Constitution be adopted to establish the grade of Student Member. Such an amendment, besides making available to the students the valuable publications of the Society at a nominal price, would stimulate their interest in professional affairs by establishing a closer, more direct bond with the Society, and would make almost automatic the switch-over from Student Member to Junior upon graduation.

Secondly, it was urged that a procedure be developed whereby Juniors would forward to the Society periodically a record of their professional activities, such record to be signed by their immediate superiors. This record would be kept on file, and whenever a Junior was seeking new employment, the Society could furnish to his prospective employer a complete and authentic report on his past experience and accomplishments.

The representatives from the Chapters and from the Local Sections joined in a banquet in the evening presided over by John F. McManus, Cornell '36, as toastmaster. The banquet was planned by a joint committee from the Ithaca Section and the Cornell Student Chapter. About 150 attended.

The toastmaster called upon Mr. Snyder to review the results of the conference sessions and to read the resolutions that had been adopted. Mr. Snyder also announced that Toastmaster McManus was the Cornell senior selected by the Ithaca Section to receive the Section's award for 1936. Mr. Glasser then reported on the Student Chapter session held during the afternoon. Secretary Seabury described the organization of the American Society of Civil Engineers.

Dr. Mead used as his text the words, "It's up to you," which he found on an advertising souvenir distributed at the banquet. He spoke particularly to the students, told them not to forget that commencement is just what the word means, and said that after graduation they will be forced to make decisions which in many cases will affect their future engineering careers. He urged them to decide for the right as they saw it even against heavy pressure from the opposite side.

In concluding the conference, Dean Hollister presented to Dr. Mead on behalf of the faculty of the School of Engineering at Cornell University an engrossed resolution which read as follows:

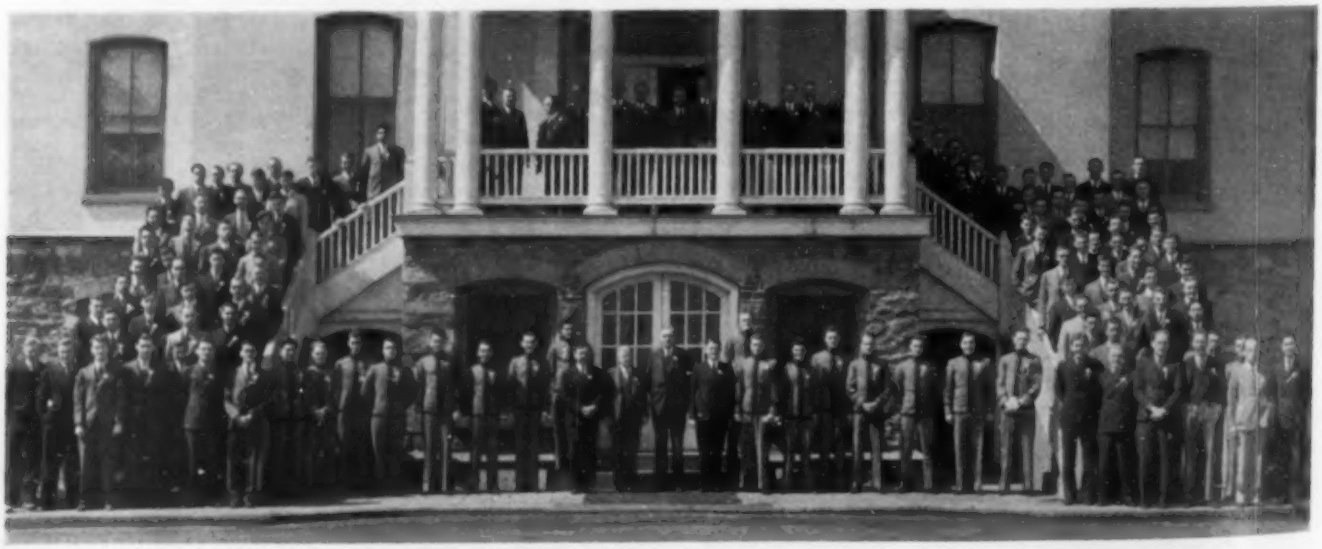
"The Faculty of the School of Civil Engineering, Cornell University, to each and to all to whom these letters may come:

"GREETING

"*Whereas* DANIEL WEBSTER MEAD graduated with high standing from this school in the year 1884 and has since then achieved professional preeminence in engineering education and in the field of hydraulic engineering, including hydrology, flood control, power development, and dam construction;

"*Therefore*, the Faculty of this school, fifty-two years later, does hereby extend to him, their one-time student, congratulations on the well-deserved recognition of his great service through his election as President of the American Society of Civil Engineers, and they rejoice in the reflected honor that comes to the school from the esteem in which he is universally held."

Data for the report on this conference were furnished by the Cornell Student Chapter.



GROUP ATTENDING CONFERENCE AT PENNSYLVANIA MILITARY COLLEGE
Society and Local Section Officials Take Part in Activities Along with Student Chapter Representatives

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies Located in 40 States

Activities of Government Agencies

Almost all administrative branches of the government are busy with the execution of programs wholly or partially financed by previous appropriations, but the planning divisions of both regular and emergency agencies are marking time until they know more about the purposes and size of appropriations which may come with current legislation. Current appropriations for social programs alone may total close to $2^1/_2$ billion, with 1,500 million for relief, 370 million for CCC, 40 million for TVA, and 200 million for social security.

According to a recent PWA survey, 83 per cent of elections, held in all but 3 of 3,073 counties in 48 states, resulted in popular authorization of bonds to cover 55 per cent of the funds to finance projects for local communities. The other 45 per cent is being provided by grants from PWA. All of that widespread popularity only involved $213,621,592 in contributions to match $150,390,286 in grants, making a total of $364,011,878. In that connection, it is interesting to note that the total is small in comparison with the normal volume. Secretary Ickes reports that over 90 per cent of the projects involved have advertised for bids and that almost 80 per cent of them are under construction or complete. He says that the overall average cost to the government of giving one man work for one year on the first thousand projects was $741.60. That figure, however, is based upon the old PWA policy of 30 per cent grant instead of the present 45 per cent and does not include any portion of the major cost of projects borne by local communities.

Although the bill for the ten-year program of REA (Rural Electrification Administration) is still in conference, it is expected to pass this session. In the meantime, invitations to bid on the construction of rural electrification projects have been issued by Electric Service Cooperatives and Associated Private Utilities in a number of states; and 20 of the 27 projects on which loan contracts have been executed are, or soon will be, in the construction stage. It also seems that the Rural Electrification Administration is trying to keep the usual channels of trade open for wiring and appliance business in the rural areas.

A surprisingly large amount of work is credited to CCC in an official report recently prepared by Director Robert Fechner for the White House. It states that 1,600,000 men and boys have found an average of 8 months' employment in that service. They have worked under the direction of the Departments of War, Interior, and Agriculture in every state in the Union on 17,500,000 acres and have built or repaired 69,000 miles of service roads and trails, 42,000 miles of telephone lines for fire protection and park service, 47,000 miles of fire breaks through forested areas, 2,500 lookout houses, 1,900,000 soil-erosion check dams in gullies, 25,000 vehicle bridges; and have planted 558,000,000 forest trees over denuded areas. All of this is now reported to have an actual value of more than $600,000,000, not including its social and economic value.

With the President's support, WPA now seems almost certain to be entrusted with another billion and a half relief appropriation for 1936–1937. It is now scheduled to be included in the deficiency appropriations. No ear-marking beyond Mr. Hopkins' estimate of over $500,000,000 for roads and the more permanent type of construction is in evidence, but he has promised "a more useful" program. Added to the estimated balance from 1935–1936, after all corrections, such an appropriation may total approximately $2,500,000,000 for relief and work relief.

Relation of Engineers to Creation of Employment

All of the Washington palliatives have failed so far to make any real dent in the number of unemployed. Estimates of unemployed vary from eight million to fourteen million, but the estimators, whether they are on the high side or the low side, have not changed their estimates materially in three years. On the other hand, it is known that there is a definite shortage of skilled help in the building trades in some localities, and if we should have any large advance in the machinery industries, there would be a dearth of skilled mechanics, toolmakers, and other trained craftsmen.

The government policy continues to be a "work-relief" policy under WPA. Many engineers are employed in PWA and WPA and in some 70 other government departments or divisions. Indications are that during the months to come an increasing number of men will be dropped from the government payrolls, including several thousand engineers. Meanwhile, private employment of engineers is slowly increasing. One of the indexes of this increase is seen in the return of engineers to membership in local and national engineering organizations.

Engineers, however, have more than a personal relation to questions involved in our national reemployment policies. With the return of more normal conditions, the engineer is an employment creator. At the meeting of the U. S. Chamber of Commerce, several phases of the problem of reemployment were presented, and a very real stimulus given to the thought that new products, new services, and new inventions, all engineer-created products, presented one of the most hopeful opportunities for the reemployment of capital and consequently the reemployment of men.

Under the WPA, $12,000,000 was allotted last December for a study under a national research program of "reemployment opportunities and the changes in the techniques of production." This study is just getting under way under the direction of Dr. David Weintraub, with headquarters at Philadelphia, Pa. Some of the factors that are proposed include the measurement of the volume of technological unemployment; changes in productivity in selected groups of industries; and the historical analysis of the development of techniques in relation to the development and standards of living.

There is need of engineering statesmanship in a consideration of this total problem. There are at present no basic statistical data upon which decisions can be made as to the influence of technology on employment. American Engineering Council's committee on the relation of consumption, production, and distribution has expressed the belief that an "economy of abundance must replace an economy of scarcity," to use the latest phrase, if we are to find the answer to a rising standard of living in the United States. Several areas of this whole question can profitably be studied from an engineering viewpoint, and it is anticipated that the committee on engineering economics of American Engineering Council will give consideration to some of these questions.

Committee Activities of Council

Organization of all divisions of Council's committees is complete. Every engineer asked to serve has accepted the responsibility with an eagerness to advance the public's appreciation of the value of engineering judgment, training, and experience. Many of the committees have already gone into action, and most engineers engaged in the work will be included in programs of committee activities which will soon be ready for distribution.

The report of the committee on production and distribution is in the final revision stage and will soon be submitted to member organizations. The committees on public works, and conservation and utilization of natural resources are completing the first reports of their respective programs. Favorable action has already been taken to support a new Court of Patent Appeals, and the patents committee is now engaged in the preparation of recommendations for the improvement of patent procedure.

Legislation and Government Regulation

It is Council's policy to follow all bills affecting engineers and engineering as well as those affording opportunities to act in the public welfare. With Council's improved committee organization, it is hoped that it will be able to present considered opinions to the proper authorities in time for them to be used in connection with the enactment of legislation of that nature.

New government regulations are seldom issued under present conditions, but it is evident that many of them are in preparation and as soon as the new programs are approved, a lot of new rules, regulations, and procedure are likely to become effective. Advance information regarding most of it indicates improvement in the practices of the emergency agencies.

Omnibus Flood Control Bill H.R.8455 is reported out of committee but it is said to have slim chance of passage. Senator Cope-

land's S.4315 declaring "floods constitute a menace to national welfare," and authorizing $5,000,000 for flood control surveys throughout the United States by the Engineers Corps of the Army, is in the hands of the Commerce Committee of the Senate. They have asked the Chief of Engineers for an opinion and propose to report it in time for consideration.

Council's public affairs committee has made a study of legislation proposed for the creation of a permanent National Planning Board or the continuation of the National Resources Committee. They are divided in their opinion regarding current legislation, but most of them favor sound planning by a non-political organization under otherwise favorable circumstances. There is no indication that legislation of this nature will pass this session of Congress, but plans are being made for the introduction of a modified and more constructive form of legislation for the same purpose in the Seventy-Fifth Congress. The conception of a National Planning Board, as presented by the National Resources Committee, is not understood by many people. In Congress it is still interpreted, primarily, as an agency of the Secretary of the Interior and a "brain trust" engaged in long-range social planning of no immediate practical purpose.

Although the House and Senate have each passed bills—H.R. 11663 and S.2512—defining lobbyists and providing for their regulation, neither bill is acceptable to both houses and it seems likely that the disagreement will prevent either of them from being favorably reported out of conference for action during this session.

Hearings on the Lonergan bill, S.3958, "to prevent pollution of navigable waters," and S.3959, "to amend the Act of 1899 controlling discharge of refuse in navigable waters and the Act of 1924 preventing oil pollution" before Senator Caraway's subcommittee are complete, but not reported out of committee. The Copeland bill, S.4342, "to create a Bureau of Stream Pollution in the Bureau of Public Health Service," and the Barkley bills, S.4349, S.4350, and S.4351, "to control or reduce the pollution of the navigable waters of the United States and granting Ohio Valley consent of Congress to an interstate compact for that purpose," have all been referred to the Senate Commerce Committee, which does not expect to act on them. In the House, the Mansfield bill, H.R.8992, has been superseded by the Pfeifer bill, H.R.11064, "to prevent pollution of rivers and harbors of the United States"; and the Hollister bills for the same purpose have been referred to the Committee on Rivers and Harbors of the House, which does not anticipate action. Relief and taxation constitute "must" legislation for the remaining days of this session.

Washington, D.C.
May 8, 1936

Spring Meeting Receives Wide Publicity

THE SPRING MEETING at Hot Springs, Ark., last month was the first quarterly meeting at which the Society's recently organized publicity department had an opportunity to function. The results, in terms of the amount and distribution of newspaper attention, were gratifying.

Preliminary work to obtain publicity for the meeting was carried on in New York for some time before the first session opened in Hot Springs. Newspapers in 15 southern states were supplied with advance stories of the meeting and, whenever available, with photographs of the Society officers and of those scheduled to speak. The home city newspapers of each of the speakers on the program were furnished stories stating that a local man was to address the civil engineers and giving the title of the paper he was to deliver.

Contacts were made with the headquarters of national press associations in New York, with the publicity department of the Hot Springs Chamber of Commerce, and, at Hot Springs and Little Rock, with local newspapers, local correspondents for out-of-town newspapers, and other publicity outlets. Personal cooperation with the working press in Hot Springs was maintained constantly both before and during the meeting.

A preliminary report of the results of these efforts follows:

Number of column inches of newspaper space obtained	905¾
Number of papers that published stories about the meeting	53
Number of cities in which such stories appeared	42
Number of states in which those cities are located	17

Translated into other terms, the space obtained is equivalent to more than 45 ordinary newspaper columns. Additional clippings are being received as this issue of CIVIL ENGINEERING goes to press.

Uniformity Sought in Engineering Degrees

EDUCATORS in the field of engineering and members of engineering societies have on several occasions concerned themselves with the lack of uniformity in engineering degrees and the consequent confusion arising from the various practices of engineering schools. The Society for the Promotion of Engineering Education (S.P.E.E.) has had three different committees and reports on the subject, and the Engineers' Council for Professional Development (E.C.P.D.) has recognized the problem in the deliberations of its Committee on Professional Recognition.

The latest reports of the S.P.E.E. committee on degrees in engineering, presented at the Ithaca meeting in 1934, contained provisions for unifying the names of, and requirements for, engineering degrees, including honorary degrees. The Committee on Professional Recognition of E.C.P.D. heartily concurred in this report, with one exception, and urged its adoption as a step in clarifying the present situation. The single exception was taken to the proposal to abandon completely the professional degree, and E.C.P.D. expressed the hope that this proposal would receive further consideration by S.P.E.E. before adoption.

Using civil engineering as an example typifying the lack of uniformity and confusion in all engineering degrees, S.P.E.E. found the following forms of the first, or bachelor's, degree:

Bachelor of Arts
Bachelor of Science
Bachelor of Science in Engineering
Bachelor of Science in Civil Engineering
Bachelor of Engineering
Bachelor of Civil Engineering
Civil Engineer

In contrast to this diversity, the S.P.E.E. committee recommended the following plan for engineering degrees, again using civil engineers as an example:

DEGREE	TYPE
Bachelor's	Bachelor of Civil Engineering (B.C.E.)
Master's	Master of Civil Engineering (M.C.E.)
Doctor's	Doctor of Civil Engineering (D.C.E.)
Honorary	Master of Engineering (M. Eng.)
Honorary	Doctor of Engineering (D. Eng.)
Professional	Civil Engineer (abandon as earned or honorary)

In order to get a consensus of opinion on this plan, S.P.E.E. submitted the recommendations to letter ballot. The results of this ballot, which indicated a marked preference for the simplified forms are as follows:

	VOTES IN FAVOR	PERCENTAGE IN FAVOR	VOTES OPPOSED
Degrees earned in course:			
B.C.E.	657	81	152
M.C.E.	650	81	150
D.C.E.	639	80	156
Honorary degrees:			
M. Eng.	666	85	116
D. Eng.	702	90	78
Discontinuance of professional C.E.	474	61	304

Total ballots numbered 813 out of a membership of 2,325, representing 160 institutions, with 50 voters outside of faculties. The significance of the ballot is outstanding, and the results more than ordinarily conclusive. With the exception of the vote favorable to abandonment of the professional degree (C.E.) the results are also in accord with the preference of the Committee on Profes-

sional Recognition of E.C.P.D. The latter organization had proposed that the professional degree might be granted only to experienced engineers who had otherwise met the requirements for certification into the profession.

Tennessee Valley Section Asks Continuance of Geodetic Work

PASSED BY the entire membership of the Tennessee Valley Section, a resolution recommending that funds be made available to the U. S. Coast and Geodetic Survey for completing the computations and adjustments of field surveys has been forwarded to the president of the Senate, the speaker of the House of Representatives, Tennessee state representatives and senators, the PWA and WPA administrators, and to various other officials. The text of the resolution follows:

"WHEREAS, the U. S. Coast and Geodetic Survey during the past few years has had large appropriations of emergency funds, for which a considerable amount of field work has been completed on triangulation, traverse and level geodetic control surveys; and

"WHEREAS, these emergency funds have been discontinued, the resulting situation being extensive surveys completed in the field, but the final results not available because there is no fund to complete the office computations and adjustments; and

"WHEREAS, if the survey results are not made available soon a great deal of duplication of effort will be necessary, such duplication being wasteful and uneconomical; therefore

"*Be it resolved*, that the Tennessee Valley Section of the American Society of Civil Engineers recommends that funds be made available to the U. S. Coast and Geodetic Survey, for the purpose of completing the computations and adjustments of field surveys, as a step toward preventing waste of public funds, and also to make the basic data available for public use; and

"*Be it further resolved*, that copies of this resolution be sent to the President, Secretary, and Board of Directors of the parent Society with recommendation that this resolution be approved, and copies forwarded to the Director of the Coast and Geodetic Survey, the Secretary of Commerce, the Director of the Bureau of the Budget, the Administrator of the Public Works Administration, the Speaker of the House of Representatives, and the President of the Senate."

Milo S. Ketchum Award

THOSE WHO graduated from the University of Colorado in civil engineering during the time that the late Milo S. Ketchum was dean at that institution have joined with his friends in raising a fund to be used for what will be known as the Milo S. Ketchum Award. Principally on account of Dean Ketchum's keen interest in the Society, it has been decided that the honor shall be given for a combination of qualifications in scholarship, character, and Student Chapter activities, leading to affiliation with the Society as a Junior.

This award has been so constituted as not to conflict in any way with the one now being bestowed by the Colorado Section. The first recipient will be determined during the current spring. Because the details of the award so intimately concern the coordinated activities of the University and the Society, and therefore will prove of interest to all members, they are given here in full:

"The funds which have been raised by subscription for the Milo S. Ketchum award shall be placed in the hands of the Comptroller of the University of Colorado, with a stipulation that a sufficient portion of these funds (probably $500.00) will be considered to be a trust fund and invested conservatively, probably in government bonds. Any surplus over and above the amount necessary to insure the expenses incident to the Ketchum Award will be known as the Milo S. Ketchum Loan Fund and shall be loaned to upper classmen of the Civil and Architectural Engineering Departments of the University Loan Committee, on recommendation of the Head of the Department of Civil Engineering and with the approval of the Dean of the College of Engineering.

"The income from the trust fund shall be used to defray the expenses incident to the Milo S. Ketchum Award, which shall consist of the payment of the initiation fee for Junior Membership in the American Society of Civil Engineers and a pin. If possible this fund shall also provide for a bronze tablet which will be hung in the halls of the Engineering Building. This award shall be made annually to a senior who is in line to graduate from the Department of Civil or Architectural Engineering.

"The specifications which shall be followed in selecting the man who is to receive the award are as follows: (It is recognized that these specifications are to serve as a guide in making a logical selection. No choice should be made that is contrary to the best judgment of the civil engineering staff.)

"Scholarship . . . . 50 per cent

"The man must have a quality point average at the end of the winter quarter of his senior year of at least 2.0.

"Student Chapter activities . . . . 20 per cent

"This includes interest in the University of Colorado Student Chapter of the American Society of Civil Engineers as evidenced by attending the meetings, holding office, and other interest in the success of the Student Chapter.

"Other activities . . . . 10 per cent

"This includes general University interests, such as membership on the staff of the *Colorado Engineer*, membership on intercollegiate, or intramural athletic teams, and other extra-curricular activities. Consideration should be given if a man is working his way through school.

"General characteristics . . . . 20 per cent

"This includes character, personality, personal appearance, loyalty, initiative, resourcefulness, etc.

"These specifications may be changed by a two-thirds vote of the civil engineering staff and the approval of the Dean of the College of Engineering, provided, however, any changes must be made at least three months before consideration is given to the selection of the recipient.

"The award shall be made by the Head of the Department of Civil Engineering with the approval of the Dean of the College of Engineering after the Department of Civil Engineering has agreed upon the senior who has the highest rating under the above-mentioned specifications.

"The award shall be made at a meeting of the University of Colorado Student Chapter of the American Society of Civil Engineers. No other business shall be transacted at this meeting. The principal address should be based on some phase of Dean Ketchum's work, his character, his accomplishments as an engineer and an educator, or on some phase of engineering in which he was particularly interested."

We are indebted to C. L. Eckel, M. Am. Soc. C.E., head of the department of civil engineering at the University of Colorado, for this interesting information.

In and About the Society

FOURTEEN of the 15 consultants who have been selected to assist in preparing the national water plan for the National Resources Committee are members of the Society. They include Frederick H. Fowler, director of the study, and H. K. Barrows, James F. Sanborn, William McKinney Pratt, Frederick H. Weed, Royce J. Tipton, Gerard H. Matthes, W. W. Horner, LeRoy K. Sherman, S. T. Harding, J. C. Stevens, Walter L. Huber, Ralph I. Meeker, and Samuel B. Morris. The objectives of the plan were described in the May issue of CIVIL ENGINEERING.

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STUDENT CHAPTERS making use of the Society's lantern lectures may find worthy of consideration the scheme recently tried out in the Chapter at the University of North Dakota with the lecture on the Cascade Tunnel. Lester L. Jacobs, the Chapter secretary, reports that after the text corresponding to each slide was read, the slide was held on the screen while various members of the Chapter volunteered their own explanations of the work illustrated. The entire showing and discussion required an hour and a half. The idea developed spontaneously, said the secretary, and "convinced

us that, more than just being an interesting description, these illustrated lectures are an excellent means of bringing home the fact that we are learning things here at school that are used over and over again in everyday engineering." Mr. Jacobs' letter concluded with an appreciation of the Society's assistance to Student Chapters. "I shall ever be grateful for the fact," he writes," that older and experienced men take such an interest in what a few snowbound students in North Dakota are doing—and that they are willing to spend valuable time in trying to help them along a road that at some times is quite rocky."

* * * *

THE Society's Spring Meeting at Hot Springs, Ark., was attended by a considerable number of engineers who are very well known in the profession, among them three Honorary Members of the Society. These were President D. W. Mead, Past-President Arthur N. Talbot, and Mortimer E. Cooley, a former director. Oddly enough, all these have served as professors in midwestern engineering colleges, their combined teaching experience aggregating more than a century and a quarter.

Appointments of Society Representatives

BERNARD L. CROZIER, M. Am. Soc. C.E., has been appointed a Society representative on the Paving Brick Committee of the U. S. Department of Commerce.

FRED LAVIS, M. Am Soc. C.E., has accepted appointment as one of the Society's representatives on the Division of Engineering and Industrial Research of the National Research Council.

W. J. MEAD, Affiliate Am. Soc. C.E., and CARLTON S. PROCTOR and LAZARUS WHITE, Members Am. Soc. C.E., will represent the Society at the International Conference on Soil Mechanics and Foundation Engineering to be held at Harvard University, June 22–26, 1936.

News of Local Sections

ARIZONA SECTION

The spring meeting of the Arizona Section took the form of an all-day session held at Tucson, Ariz., on April 25. The technical program consisted of talks by L. Booher and A. George Kaetz, engineers for the Soil Conservation Service, who discussed various aspects of soil erosion in the Gila River watershed and emphasized the need for the construction of dams to meet the menace of heavy floods along the river. During luncheon the engineers heard a talk by W. J. Jamieson, state administrator for the Works Progress Administration. In the evening the Section held a joint dinner meeting with the University of Arizona Student Chapter. This session was devoted to talks and demonstrations by members of the Student Chapter, and to an address by Raymond A. Hill, Director of the Society. Mr. Hill, who is a consulting engineer of Los Angeles, Calif., discussed the design of proposed work on the Salt River project.

BUFFALO SECTION

At the annual meeting of the Buffalo Section, held in the Buffalo Athletic Club on April 14, the following officers were unanimously elected for 1936–1937: William P. Feeley, president; George Minniss, vice-president; and Stewart S. Neff, secretary-treasurer. The chairmen of various committees read their reports, which were approved. The Section is proud of the fact that during the past year its membership has increased from 30 to 47.

COLORADO SECTION

There were 51 members and guests present at a dinner given by the Colorado Section on January 13, and 16 additional members came in for the meeting that followed. The list of speakers included Elmer Otto Bergman, associate professor of civil engineering at the University of Colorado, and E. D. Smith, of the U. S. Bureau of Reclamation. Their papers were discussed by I. K. Silverman and Fred A. Houck. At a dinner meeting given by the Section on February 10, the speakers were R. K. Allen, administrative engineer of the U. S. Land Office; J. E. King, chief of maps and surveys for the U. S. Forest Service; and Mr. McConaughy, of the U. S. Bureau of Reclamation. There were 44 present at the dinner, and 24 additional members and guests at the meeting. The regular March meeting of the Section was held on the 17th, with an attendance of 53 at the dinner and 68 at the meeting. On this occasion the feature of the technical program was the presentation of a paper by Louis R. Howson, member of the firm of Alvord, Burdick and Howson of Chicago, consultants on Denver's new west side filter plant. Since Mr. Howson was unable to be present the paper was read by Charles B. Burdick, another member of the firm. Among those participating in the discussion was Herbert S. Crocker, Past-President of the Society.

A regular meeting of the Association of Junior Engineers of the Colorado Section was held on January 27, with 30 present. Short talks were given by members of the Public Service Company on street and highway lighting. A meeting of the Association was held on April 27 in honor of Walter E. Jessup, Field Secretary of the Society, who described the activities of the Society in general and discussed many points of special interest to Juniors. The other speaker was F. C. Hart, hydrographer for the state of Colorado, whose topic was "The Drainage of the San Luis Valley." There were 26 present at this session.

CONNECTICUT SECTION

The seventeenth annual meeting of the Connecticut Section was held at New Haven on April 29. At the business meeting, which preceded the dinner and technical session, the following officers were elected for the ensuing year: Harold L. Blakeslee, president; Henry W. Buck, vice-president; and Joseph P. Wadhams, secretary-treasurer. The technical program consisted of talks by William J. Cox, assistant professor of engineering mechanics at Yale University, and Henry J. Fischbeck, chief metallurgist for the Pratt & Whitney Aircraft Division of the United Aircraft Manufacturing Corporation. Professor Cox's topic was "Some Traffic Problems of Connecticut," and Mr. Fischbeck spoke on the subject of "Materials Used in the Construction of Aircraft Engines." There were 32 present.

DAYTON SECTION

There were 20 present at a meeting of the Dayton Section held at the Engineers Club on April 20. Plans for future meetings were discussed, and a talk was given by Dr. William A. Beck, eminent scientist in the fields of chemistry, physics, and biology. Dr. Beck's subject was "Man and His Environment."

DETROIT SECTION

At a meeting of the Detroit Section, held at the Hotel Statler on April 3, speakers representing five engineering colleges in the state of Michigan contributed to a symposium on "Problems in Engineering Education." Grover Dillman, president of the Michigan College of Mining and Technology, was unable to be present, but was ably represented by an alumnus, Colburn Standish. Lewis Gram, professor of civil engineering at the University of Michigan, made a general analysis of engineering education, and Prof. Chester Allen discussed the problems of Michigan State College. Talks by Prof. Clair C. Johnston and Dean A. C. Carr, of the University of Detroit and Wayne University, respectively, concluded the symposium. There were 35 present.

DULUTH SECTION

On March 16 the Duluth Section held a regular meeting, which was attended by twelve members and one guest. The speaker on this occasion was Maj. I. B. Hill, who discussed the subject of preparedness and outlined the foreign conditions that may lead to war. At the meeting held on April 20 there were fifteen members and three guests present. At this session Rodney Paine, superintendent of the Duluth park system, described a new WPA project for the development of Park Point in Duluth as a recreation center. This project involves developing an area filled by spoil from a harbor-deepening project completed in previous years.

Georgia Section

A joint meeting of the Georgia Section of the Society and the Georgia School of Technology Student Chapter was held on April 13. The speakers were J. F. Howard, president of the Student Chapter, and F. L. Carothers. Mr. Howard spoke on the relationship of the Student Chapter to the Society, and Mr. Carothers commented on the value of the Student Chapter conference held in Birmingham, Ala., at the time of the Fall Meeting of the Society. He also discussed the advantage of affiliation with the Society after graduation. Then Prof. R. P. Black mentioned the fact that older engineers welcome contacts with engineering students and M. T. Singleton, president of the Section, urged that students attend all Section meetings.

Ithaca Section

On April 23 the Ithaca Section of the Society and the Cornell University Student Chapter held a joint meeting in Ithaca. The guest speaker was Dr. Heinrich Ries, professor of geology at the university, who gave an instructive illustrated talk on the subject of clays and sands. There were about 100 members and guests present.

Louisiana Section

The new officers of the Louisiana Section are as follows: Clifford H. Stem, president; H. A. Sawyer, first vice-president; William H. Rhodes, second vice-president; Charles M. Kerr, secretary; and A. J. Negrotto, treasurer.

Mid-South Section

The regular annual business meeting of the Mid-South Section was held in Hot Springs, Ark., in conjunction with the Spring Meeting of the Society. At this session the following officers for 1936–1937 were elected: John H. Gardiner, president; Walter F. Schulz, vice-president; W. W. Zass, secretary-treasurer; and H. F. Nugent and L. F. Reynolds, directors. The other members of the board are L. R. Parmelee and J. H. Haylow, who were elected last year for a two-year term, and George R. Clemens, former president who is a director ex-officio.

Philadelphia Section

On April 15, at the first meeting of the kind ever to be held by the Philadelphia Section, Juniors took charge of the session and gave a very good account of what the younger men are doing in both theory and practice. At this meeting, which was conducted by A. Harry Wagner, the speakers were Harry J. Engel, assistant engineer for Modjeski, Masters and Case, who presented a paper on "Mississippi River Bridges from St. Louis to New Orleans"; W. G. Stevens, Jr., an engineer for the Philadelphia and West Chester Traction Company, who described a local bus and rail terminal now under construction; and S. T. Carpenter, instructor in civil engineering at Swarthmore College, whose topic was "Wind Stresses and the Tall Building." At the conclusion of the technical program Lyle Jenne was presented with a gold chain and knife as a token of the Section's esteem for his work as chairman of the social meetings over a period of several years. There were 65 at the meeting, and 34 at the dinner preceding it.

Pittsburgh Section

The annual meeting of the Pittsburgh Section was held at the Hotel William Penn on April 28. The attendance numbered 60 members of the Section and 60 Student Chapter members from West Virginia University, Carnegie Technical School, and the University of Pittsburgh. The annual election of officers, which took place at this time, resulted as follows: C. G. Dunnells, president; R. P. Forzberg, vice-president; Nathan Schein, secretary-treasurer; and J. F. Laboon, C. F. Goodrich, and L. W. McIntyre, directors for a two-year term. The technical program consisted of the presentation of papers by the following Student Chapter members: J. J. Rotheram, of the University of Pittsburgh, who spoke on frost action on soil subgrade; George R. Wells, of West Virginia University, whose topic was "A Trip to the Moon"; and Fred Daturs, of the Carnegie Institute of Technology, who described one of the state's new major highways. Then E. K. Morse, former Director of the Society and member of the Water and Power Resources Board of Pennsylvania, spoke on the subject of flood prevention. At the conclusion of the meeting refreshments were served.

Portland (Ore.) Section

A regular monthly meeting of the Portland (Ore.) Section was called to order on April 17, with 67 present. After preliminary announcements Neil Craig, district traffic manager of the United Air Lines, discussed the development of commercial air transportation. Mr. Craig then introduced one of the pilots connected with these lines, who spoke on the operation of transport planes. The next speaker on the program was James H. Polhemus, president of the Section. Mr. Polhemus, who is general manager and chief engineer of the Portland airport, discussed the subject of modern airport design. The final talk in the symposium on flying was given by a local electrical engineer, who described the problems involved in adequate airport lighting.

San Francisco Section

There were 206 members and guests present at a meeting of the San Francisco Section held at the Engineers' Club on April 21. An interesting talk on the design and construction of the San Francisco–Oakland Bay bridge as a contribution to the art of bridge building was given by Glenn B. Woodruff, engineer of design for the San Francisco Bay Bridge Commission. The Membership Committee reported a net gain of eleven members since the last meeting, bringing the total membership to 531.

Seattle Section

In March the Seattle Section took its turn in sponsoring the eleventh annual joint meeting of local branches of the four Founder Societies. The principal speaker on this occasion was Alvin F. Darland, field engineer for the Coulee Dam project, who discussed the engineering problems involved, the purpose of the dam, and the reclamation and power potentialities of the project. Mr. Darland's address was well illustrated by slides showing construction details and the surrounding terrain. The April meeting of the Section followed a dinner given at the Engineers' Club on the 27th. To mark the first anniversary of the Board of Examiners, created by the Washington State Engineers License Act, the Section unanimously passed a resolution of commendation on the Board's honest efforts. Following the business session, Frederick T. Kirsten, professor of aeronautical engineering at the University of Washington, described the wind tunnel now under construction at the university. The wind velocity in the throat, which is to be 8 by 12 ft in cross section, will be 250 mph. Additional capacity will be provided in future to give a velocity of 300 mph. One of the unique features is the photo-electric cell type of scales and meters which can be photographed instantaneously. This model, which is the invention of Fred S. Eastman, assistant professor of aeronautical engineering at the university, will enable commercial firms to receive secret tests as their reports will be recorded on undeveloped films.

Spokane Section

A joint meeting of the Spokane Section and the University of Idaho and Washington State College Student Chapters was held in Moscow, Idaho, on April 2. Short talks were given by visiting members and the presidents of the Student Chapters. The speakers stressed the importance of continued interest in Society affairs after graduation and the advisability of maintaining contact with the Local Sections. There were 65 present. The regular monthly meeting of the Section was held at the Davenport Hotel in Spokane on April 10. At this session the city engineer of Walla Walla, Wash., described a WPA flood control project on Mill Creek that will prevent further damage to Walla Walla by flood.

St. Louis Section

At a meeting of the St. Louis Section, held at the Mayfair Hotel on April 27, the Reverend Dr. John S. Bunting gave a talk on Gen. Robert E. Lee. Dr. Bunting, who was a friend of the Lee family, called attention to the fact that General Lee was a civil engineer, and that his work in removing sand bars from the St. Louis harbor in 1841 brought him into national prominence. Dr. Bunting stated that a series of letters recently come to light, and now in the possession of the Missouri Historical Society, prove that this work

was the reason for Lee's being selected to go to Mexico as assistant to Gen. Winfield Scott. The 31 members present were much interested in this connection between their locality and the great general.

Tennessee Valley Section

The Muscle Shoals Subsection of the Tennessee Valley Section held its monthly meeting on April 8 at Wheeler Dam. There were 22 present. The feature of the occasion was an illustrated lecture on welding given by J. E. Balden and R. L. Allen, of the Linde Air Products Company.

On April 2 the Knoxville Subsection held its regular monthly meeting at Mascot, Tenn., where it was the guest of the American Zinc Company. This meeting was in charge of H. A. Coy, superintendent of mines for the company, who conducted the 150 members and guests through the mines. After the trip through the mines supper was served, and the company geologist discussed the geological features of the workings. During the ensuing discussion the general manager explained the various factors involved in the mining and marketing of zinc. On April 13 the Knoxville Subsection held a joint meeting with the Knoxville Technical Society, at which the guests of honor were D. W. Mead, President of the Society; Harrison P. Eddy, Past-President of the Society; and representatives of the McGraw-Hill Company and the Mississippi River Commission. Dr. Mead addressed the group numbering more than a thousand.

Texas Section

On April 29 President Mead was guest of honor at a luncheon given in the Baker Hotel at Dallas by the board of directors of the Texas Section. Walter H. Meier, president of the Section, was in charge of the luncheon, which was attended by numerous local officers. Following the luncheon, the board held a business meeting at which various matters were discussed with Dr. Mead. E. P. Arneson, Director from District 15, gave a report on the Spring Meeting of the Society. In the evening Dr. Mead was entertained at a dinner and reception held at the Athletic Club in Dallas.

Virginia Section

The spring meeting of the Virginia Section took the form of joint sessions with the Hampton Roads Engineers' Club and local branches of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. The joint meeting convened at the Hotel Monticello in Norfolk on April 17. After a business session, an illustrated talk on the making of iron pipe was given. In the afternoon Thomas P. Thompson, city manager of Norfolk, discussed the subject of city managership, and Morton Macartney gave an illustrated talk on the San Francisco–Oakland Bay bridge. The members then boarded a tug furnished by the Norfolk and Western Railway and were taken down the harbor to inspect the railroad's new coal pier. A dinner dance attracted about 150 in the evening. In addition to dancing, the program included an illustrated talk on streamlined trains. On April 18 the members were taken by bus to Suffolk, Va., where they boarded an open-air railway and were taken into the heart of the Dismal Swamp to inspect large-scale lumbering operations. This trip, which was made possible through the courtesy of the Camp Manufacturing Company, was followed by a barbecue on the shore of Lake Cahoon.

Student Chapter Notes

North Carolina State College of Agriculture and Engineering

Members of the North Carolina State College of Agriculture and Engineering Student Chapter participated in the tenth annual engineers' fair held in Raleigh on April 3. Among the civil engineering exhibits were a model steel bridge with spring balances in the members to show stresses in these members, a model of a longitudinal and cross section of a modern highway, and a model water filtration plant. The climax of the fair was the annual engineers' dance, which took place in the Frank Thompson gymnasium on the evening of April 4. The fair and dance, which are high lights of the school year, were even more successful than usual.

Pennsylvania State College

On March 21 the Pennsylvania State College Student Chapter held a meeting, at which members of the local chapter of Alpha Nu, honorary astronomical fraternity, were guests. The speaker on this occasion was C. A. Rupp, of the mathematics department of the college, whose topic was shooting stars. An enthusiastic discussion followed. On April 2 the Chapter sponsored a trip to the penitentiary at Rockview, Pa., where the water supply and sewage disposal works were inspected.

Tufts College

Through the courtesy of the Jeffrey Manufacturing Company a motion picture entitled "Rivers of Dirt" was shown at a meeting of the Tufts College Student Chapter held on April 14. This picture, which showed the belt conveyor system used in the construction of Grand Coulee Dam, proved of great interest to all. Another meeting of the Chapter took place on April 28. At this time officers for the coming year were elected, the list being as follows: Gilbert Harlow, president; F. H. Cummings, vice-president; William Goodall, treasurer; William Young, secretary; and E. I. Loud, senior representative. During the session plans were made for the spring inspection trip to nearby places of engineering interest.

University of Delaware

Last October members of the University of Delaware Student Chapter converted part of their drafting room into a lounge, which is utilized for study and recreation while classes are in progress in the other half of the room. The furnishing includes comfortable chairs, a ping-pong table, reading lamps, a radio, a typewriter, books, and chess and checker games. The window curtains are decorated at the bottom with replicas of the Society badge, and files of the Society publications are at hand. There are obsolete engineering instruments on display, including an early theodolite and a compass and level used in the construction of the first railroad in the United States. The head of the engineering school faculty stated that this arrangement has improved the tone of the whole department. Between classes students gather in the lounge to discuss problems, and usually a number are engaged in study. Only quiet games are permitted while classes are in session in the room.

University of Florida

The third annual engineers' fair sponsored by the University of Florida was held on May 1. The engineering exhibition arranged for this occasion by the University of Florida Student Chapter proved most interesting. There were displays of instruments, maps, photographs, and drawings and models of various structures, including a three-dimension model of the Atlantic-Gulf Ship Canal. A unique feature of the occasion was the presence of roving reporters who roamed about the buildings, grounds, booths, and exhibits with a portable radio broadcasting station.

University of Maryland

On February 14 the University of Maryland Student Chapter was installed at a banquet that was attended by 68 members and guests. Among the latter were President Mead; Secretary Seabury; J. H. Gregory, professor of civil engineering at Johns Hopkins University; H. C. Byrd, president of the University of Maryland; and officers of the Section. The list also included faculty members and student chapter representatives from George Washington University, Virginia Military Institute, Johns Hopkins University, and the Catholic University of America. Dr. Mead spoke on the subject, "The Way to Success for the Young Engineer," and Mr. Seabury discussed the organization of the Society. At a meeting held on March 26 the Chapter had as its guest Harry Hall, acting chief engineer of the Washington Suburban Sanitary District, who described the growth and development of the District. At the conclusion of his talk refreshments were served.

ITEMS OF INTEREST

Engineering Events in Brief

Civil Engineering for July

TECHNICAL PAPERS delivered at the Spring Meeting of the Society held in Hot Springs, Ark., April 22 to 25, 1936, were concerned principally with engineering problems of the Mississippi Valley, the Mid-South, and the Southwest. The local subjects treated included the resources and development of the lower Mississippi basin; water works and sewage treatment developments and malaria control in the Mid-South; improvement of the Mississippi and the Missouri; waterway and railroad transportation along the Mississippi system; and construction features of the Conchas Dam in New Mexico, the Fort Peck Dam in Montana, and the New Orleans Bridge.

The subject matter of the 15 papers which made up the technical part of the program will be brought to the attention of members in the July issue of CIVIL ENGINEERING in as complete a form as space will permit. Owing to the fact that the meeting was held so late in April, it has proved impossible to abstract the papers in time for the current June number.

Texas Centennial Exposition to Open June 6

TEXAS commemorates this year the one-hundredth anniversary of her independence as a republic and a state. As the outstanding feature of the celebration, the first world's fair ever to be presented in the Southwest is to open at Dallas on June 6.

Some $25,000,000 has been expended in its preparation. The largest building on the exposition grounds will be the Texas Hall of State, said to be the largest historical museum on the North American continent. It will cost, equipped, $1,200,000. The United States Building, housing exhibits of all governmental departments, is reported as the largest world's fair building ever to be erected with federal funds.

Engineers will be attracted especially to the Hall of Varied Industries, Electricity, and Communications, and to the Hall of Transportation and Petroleum. The petroleum exhibits, in particular, are described as an outstanding division of the commercial exhibits section, and cover all phases of the oil industry. Outdoor exhibits of road-building machines and other engineering equipment will also be featured.

In the general development of the exposition site, E. L. Myers, E. N. Noyes, and T. C. Forrest, Jr., all members of the Society, acted as consulting engineers.

A Famous "Bird Cage in Stone"

THIS MONTH'S PAGE of special interest pictures the ruins of St. Catherine's Cathedral at Visby, on the island of Gottland in the Baltic Sea. This edifice is perhaps the best example of Gothic architecture in the extreme northern part of Europe. Built about 1233 by Franciscan monks, destroyed by a conquering king in 1361, it was rebuilt at intervals thereafter—the choir between 1376 and 1391, the nave early in the fifteenth century, and the tower some 200 years later.

The structural engineer is immediately impressed by the slender arch ribs, which are still standing although the roof has gone. The architect notes the octagonal piers and simple caps, and sees in these features the influence of earlier Romanesque and Italian work. Any worker in the field of structures, however, cannot but admire and respect those master builders of the Middle Ages who, lacking any exact quantitative knowledge of stresses and strains, were able through judgment, experience, and daring, to evolve what have been called "bird cages in stone"—the Gothic cathedrals. These men lived with their material and came to have a remarkable feeling for its physical properties and an equally remarkable understanding of arch thrusts and vaulting. In the course of one or two centuries they refined the type of structure used in the earlier Christian church, which had been planned on the still earlier Roman basilica form, into a wonderful skeleton-stone construction that in spite of its slenderness has endured through the centuries.

St. Catherine's at Visby cannot lay claim to truly great or noble proportions, but it does recall an age of great structural achievement. It recalls an ancient and almost forgotten city as well. Once "there was no city so full of merchants and so full of commerce" as Visby. The town was, in fact, the "port of origin" of one of the earliest codes of maritime law—a code still referred to as "Laws Wisby" (another

Courtesy Swedish Travel Information Bureau, Inc.

THE GRACEFUL ARCHES OF ST. CATHERINE'S HAVE WITHSTOOD THE WEATHERING OF CENTURIES

spelling of the name) by those legal lights who struggle with the fascinating and complicated judicial procedures and problems of ships, shipping, and seamen.

Visby was founded at an unknown date and until 1361 was nominally a part of Sweden. In that year King Waldemar III of Denmark, called "The Bad," stormed and sacked the city and pro-

Courtesy Swedish Travel Information Bureau, Inc., New York, N.Y.

RUINS OF THE MEDIEVAL WALL OF VISBY, ISLAND OF GOTTLAND

Thirty-Seven Massive Towers Still Bear Witness to the Ancient Might of This City of the Famous Hanseatic League

claimed himself King of Gottland. Later Visby was rebuilt, but it never regained its former status. Gottland remained a part of Denmark until 1645, when it was reunited to Sweden by the Peace of Bromsebro.

The golden age of Visby was in the earlier days, before Waldemar came on the scene. Even before the Crusades, her ships were trafficking with the Orient, and the variety of coins dug up in recent years shows contacts with many distant lands.

The courtesy of *The American Architect* in furnishing the cut for the page of special interest is gratefully acknowledged. CIVIL ENGINEERING is also indebted to James K. Finch, M. Am. Soc. C.E., for the foregoing description and historical notes.

American Academy of Political and Social Science Meets

THE American Academy of Political and Social Science, founded in Philadelphia in 1889, grew out of a "desire for an organization in which the widespread and growing interest in political, economic, and social questions should find a focus." The Fortieth Annual Meeting of the Academy was held in the ballroom of the Bellevue Stratford Hotel in Philadelphia, April 24 and 25, 1936.

The Society appoints delegates annually to attend these meetings, the representatives this year being Scott B. Lilly, W. H. Chorlton, and B. F. Hastings, all Members Am. Soc. C.E. The following brief summary of the interesting proceedings, submitted by Professor Lilly, is printed for the information of Society members:

"The papers presented before the meeting were characterized by their insistence upon reality. There was no quibbling about conditions, but a sincere, direct, and logical attempt to see situations as they exist.

"From the first paper presented by Grover Clark, consultant on Far-Eastern affairs, which showed by a careful compilation of statistics that colonies under present conditions do not repay the mother country in profits anywhere near what the necessary system for political control costs, to the analysis of Francis B. Sayre, Assistant Secretary of State, who showed that the effect of the self-sufficiency of these nations on the common citizen would be the loss of his personal liberty, the speakers urged the necessity of trade without restraint and the exchange of services without the restraint of political regulation, if the world is to have peace.

"This open discussion of the sore spots that are now troubling nations cannot help but bring about a better understanding, and with that realization of true conditions, a sincere effort to remove the barriers to free intercourse among the nations.

"The speakers seemed to agree that if and when the world gets that freedom, wars will cease, and until that time peace, now on the tongue of every person of prominence, will be impossible. The world war which would then ensue would undoubtedly cause one or more of the present great powers to lose its status."

Wise and Otherwise

A LENGTH OF PIPE 24 in. in circumference is standing on end. Two insects, A and B, leaving a certain point on the base at the same time, crawl spirally upward around the pipe. Each insect moves in an undeviating course, and a line drawn through their positions at any time remains vertical; but B, being more energetic than A, takes a steeper course and travels 20 per cent faster. Of course they complete the circuit of the pipe at the same moment. At that time B is at the top of the pipe, while A is 11 in. below. What is the length of the pipe?

May's problem concerned 100 students taking Professor Abercrombie's course in bridges. Four subjects were taught simultaneously—arch, bascule, cantilever, and draw bridges. Each student was to study one subject exclusively for one week, and each week there was to be a new arrangement, the number studying any given subject not being the same for any two weeks. Each week the students studying arch and bascule bridges were to number 19; those studying bascule and cantilever, 55; and those studying cantilever and draw, 81. At least one student was to take each subject each week. This program was to continue for as many weeks as possible.

The questions asked were: "What was the smallest number taking draw bridges in any one week? How many students took bascule bridges during that same week? How many weeks did this variable arrangement continue?"

From the relations given, $A + B + C + D = 100$

$A + B = 19;\ B + C = 55;\ C + D = 81$

Solving for A, B, and C in terms of D,

$$A = 45 - D \quad [1]$$
$$B = D - 26 \quad [2]$$
$$C = 81 - D \quad [3]$$

From Eq. 2, since B cannot be less than 1, D cannot be less than 27. From Eq. 1, since A cannot be less than 1, D cannot be more than 44. Then the arrangement cannot continue beyond $D = 27$ to $D = 44$, or 18 weeks.

The problem is thus solved much more simply than is apparent at first sight. Furthermore, from Eqs. 1, 2, and 3, the number of students taking arch, bascule, and cantilever bridges any given week is fixed as soon as the number taking draw bridges is determined upon. These relationships can be expressed readily in the accompanying Table I.

Suggestions for other problems for Professor Abercrombie's column, accompanied by solutions, may be addressed to the editor. Solutions should preferably be sent in separate enclosed envelopes.

TABLE I. NUMBER OF STUDENTS IN PROFESSOR ABERCROMBIE'S CLASSES IN BRIDGES

SUBJECT TAKEN	WEEK NUMBER																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Arch bridges	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Bascule bridges	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Cantilever bridges	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37
Draw bridges	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44

Soil Mechanics Conference

ATTENTION is again invited to the forthcoming international conference on soil mechanics and foundation engineering to be held at Harvard University in Cambridge, Mass., during the week of June 22, 1936. A preliminary announcement appeared in the January issue of CIVIL ENGINEERING.

Persons wishing to attend only certain meetings will be exempt from the payment of fees, and the printed abstracts will be available to them at cost. It is pointed out that only papers that are of general interest and that lend themselves particularly well to the purpose will be presented orally. The whole field of soil mechanics—both the theoretical aspects of the subject and their practical application—will be covered in the various sessions.

Standard Thread for Surveying Instrument Tripods

A TRIPOD thread having a nominal diameter of $3^1/_2$ in. and 8 threads per inch has been adopted by various U. S. Government agencies as standard for use with transits having horizontal limbs $4^1/_2$ in. or more in diameter at the edge of graduation, and also for all engineers' levels. The agencies referred to include the War Department, the hydrographic office of the Navy Department, and the Geological Survey.

The National Bureau of Standards has prepared a letter circular known as LC 463 to answer requests for detailed information in regard to the thread. This letter circular may be obtained without charge on application to the National Bureau of Standards, Washington, D.C.

The object sought in standardizing the tripod thread is complete interchangeability, so that the base plate of any standard instrument will fit satisfactorily any tripod head, regardless of manufacture. Interchangeability can be obtained only by adequate dimensional specifications for the threads and the use of an adequate gaging system in inspection. Seven manufacturers of surveying instruments have authorized the Bureau to state that they have accepted this as their standard thread, and six additional manufacturers have stated that they are supplying it on request.

Improving the Well-Water Supply in Peiping, China

By P. K. Tao and C. S. Hsieh

Respectively Professor of Sanitary Engineering and Assistant of Sanitary Engineering, National Tsing Hua University, Peiping, China

Sanitation in China presents many interesting problems different from those in Europe and America. For example, in Peiping—a city of a million inhabitants—only about 15 per cent of the population is using the city water; the remaining 850,000 inhabitants depend upon wells. The sanitation of well water is therefore a problem of utmost importance.

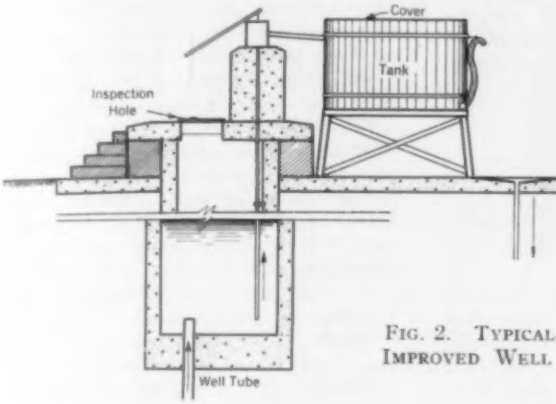


Fig. 2. Typical Improved Well

In Fig. 1 is shown a typical well, consisting mainly of a tube terminating in a basin into which the water rises under its own pressure. The tube is either of iron or of bamboo (the life of the latter material is about 15 years). The wall of the basin is of brick and plaster, but is not watertight. Very few wells have curbs and none has a cover. Many of the platforms slope toward the well, and surface pollution is unavoidable. Moreover, most of the wells are located within 50 ft of latrines, which are also poorly constructed. Thus ground-water pollution is also quite possible.

Water is drawn up in willow buckets and poured into uncovered wooden tanks, from which it is transferred to one-wheeled water carts with a wooden scoop. The orifices in the carts are controlled by hand-operated wooden stoppers.

As might be expected, the water in these wells is highly contaminated. The average bacterial count from 34 wells in 1934, was 206 per cc at 37 C, and the average percentage gas formation in the B. coli tests was 25.

In 1932 the municipal health department adopted chlorination with bleaching powder as the remedy for pollution in all the drinking wells in Peiping, each well being chlorinated once or twice daily. The results, however, were unsuccessful, largely because water is drawn from the wells frequently, while the dosing is intermittant, and because, although the water is disinfected in the well, it is again contaminated during lifting and transportation. Furthermore, the method is not economical.

The unsatisfactory results of chlorination led the authors to study how the wells could be remodeled to yield safe water. The well at Soochow Hutung was chosen for the experiments. Within 40 ft of it are a cesspool and a stable, and within 100 ft there is a latrine. The wall of the basin is brick.

We first plastered the basin with a 2-in. layer of cement mortar, but this did not improve the quality of the water. So a concrete cover was added to the basin and a hand pump installed (Fig. 2). This was successful. The highest bacterial count in 17 samples taken after the installation was only 60 per cc, and the fermentation test for B. coli was negative in every sample.

Storage in the open tanks at ground level offered another good opportunity for contamination. We raised the tank of the experimental well to a height of 3 ft above the ground, covered it tightly with galvanized iron, and inserted brass faucets to take the place of the wooden scoops. Pollution of water during transportation proved to be slight, and was eliminated by replacing with faucets the wooden stoppers in the carts.

These improvements have now been made on 13 wells at a cost of about $30 (U.S.) for each well. We hope that in the near future the water supply of the entire population of Peiping dependent on wells can be rendered safe at similarly low costs.

The Experimental Well at Soochow Hutung—A One-Wheeled Water Cart Can Be Seen at the Left

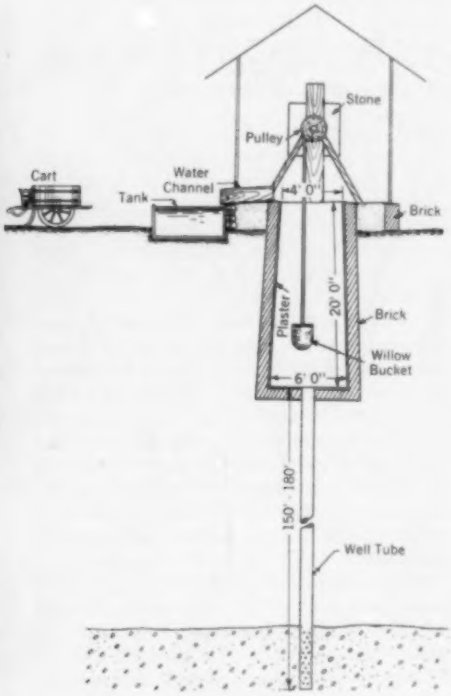


Fig. 1. Unsanitary Wells Like This Have Been Supplying 850,000 Persons in Peiping, China, with Water

Summer Session in Engineering Economics

The Society for the Promotion of Engineering Education has accepted the invitation of Stevens Institute of Technology to hold a summer session on the economics of engineering at the Stevens Engineering Camp, Johnsonburg, N.J., during the week beginning June 28. Those attending will be for the most part teachers of economics in engineering schools and colleges.

There will be two morning sessions and one evening session each day from June 28 until Sunday evening, July 5. Afternoons are to be reserved for recreation and for informal conferences and discussions. In seven of the morning sessions a series of lectures on economic theory will be presented under the supervision of Prof. Horace Taylor and Raymond J. Saulnier of Columbia University. Another series of morning lectures, in which professors, economists, and industrialists will participate, will deal with economic aspects of engineering. In the evening lectures on "Economics Today," more general topics, such as labor relations, social security, and monetary legislation, will be discussed.

Among the members of the committee on program and arrangements for the forthcoming session are H. P. Hammond, M. Am. Soc. C.E., and E. L. Grant, Assoc. M. Am. Soc. C.E.

Summer schools for engineering teachers have been held by the S.P.E.E. in various institutions throughout the country since 1929. The first summer school in economics of engineering was conducted with the cooperation of Stevens Institute of Technology on the college campus at Hoboken four years ago.

Importance of Trade Associations

PROFESSIONAL organizations have certain characteristics in common with trade associations, since they attempt to do for their particular groups what the trade associations do for individual industries.

Hence those concerned with Society affairs will find pertinent a number of the comments made by Harper Sibley, president of the Chamber of Commerce of the United States, in an address on "American Trade Associations" delivered before trade association executives in January 1936. The following statement, for example, is true of both types of organization: "There is no limit on the demands made upon the talents of the executive of an association that is striving to discharge all of its obligations."

In another place he quoted Elihu Root as stating: "Men influence the conduct of others chiefly through personal association and intercourse. There is such a preponderance of good in human nature that association with men ordinarily begets a liking for them. As men come to know each other, each comes to receive from the others the respect and confidence to which he is entitled; his character and his opinions insensibly acquire their due weight and influence. It is not the stranger who says, 'Go there,' or 'Do that,' who is obeyed, but it is the old acquaintance who says, 'Come with me,' or 'Let us do thus and so,' who is followed."

Referring to the legal rights of men in business to associate with one another, Mr. Sibley remarks that "In probably no field of law has the Supreme Court more scrupulously endeavored to weigh and to define the rights and the obligations of the several interests involved—the public, the industry, and the individual—than in the law relating to trade associations." And again, "To the association is assured the privilege of working to protect its industry from within and from without, of pointing the way of development, and of collecting and distributing information concerning existing conditions in the industry which will enable its members to conduct their own business operations most intelligently in their own best interest."

One other statement from Mr. Sibley's address might be applied to engineering societies, that "Every trade association has before it a great range of tried and tested activities from the rich experience of associations over a period of fifty years and more—experience into which a wealth of ability and effort have gone."

Engineers' Day at Great Lakes Exposition

A COMMITTEE representing the Cleveland Engineering Society, the local sections of the national societies, and other technical and semi-technical organizations, has extended an invitation to Society members to be present in Cleveland on July 11, 1936, when "Engineers' Day" will be held at the Great Lakes Exposition. After a luncheon on the grounds and appropriate ceremonies, the remainder of the day will be devoted to the romance of iron and steel.

The exposition, which is itself dedicated to the subject of iron and steel, marks the one-hundredth anniversary of the incorporation of the City of Cleveland. The opening date of the exposition is June 27, 1936, and it will run for one hundred days, or until October 4.

Harvard Engineering Society Student Aids Available

AVAILABILITY of the Clifford M. Holland Memorial and the Lillie A. Ridgway Memorial aids in engineering for the academic year 1936–1937 at Harvard University has recently been announced. An annual stipend of several hundred dollars from the income of each of these funds may be awarded to one or more students in Harvard in engineering or engineering sciences. Applicants for such student aid should apply to Charles Gilman, Chairman, Committee on Student Aid, Harvard Engineering Society, at 50 Church St., New York, N.Y.

Yale Exhibits of Engineering and Chemistry

ON FEBRUARY 21 and 22, 1936, the chemical and engineering laboratories of Yale University were opened to the public in the first "Yale Exhibits of Engineering and Chemistry." This type of student enterprise has been developed to a high point by most engineering schools in America, but this year, for the first time at Yale, these exhibits were coordinated into a large, two-day program, including several laboratories which had never been opened before, such as those of the civil engineering department. In planning and making the necessary arrangements, the student advisory committee received much valuable help from Dean Robert E. Doherty of the engineering school and other members of a special faculty contact committee.

Each engineering department's exhibit was planned by its particular student chapter of a national engineering society with the aid of faculty advice, and the department of chemistry, which was invited to join the engineering departments, appointed a special student committee which worked closely with the faculty. While the exhibits themselves were carried on by the juniors and seniors, about 15 sophomores were placed at the entrances of the laboratories to give information service.

In the civil engineering laboratories, the first room entered by the visitors was lined with pictures and maps of the 2,000-acre Yale engineering camp, drawings of Yale buildings, and examples of various types of student work. Of particular interest in the hydraulics laboratory were a working model of Yale's unique indoor rowing tanks, in which the water is circulated by impellers, and a fine model of the Passamaquoddy tidal power project. The latter was made especially for the exhibition from a mixture of cement, sawdust, and sand, cleverly painted and furnished with power houses and a transmission line. As a student behind the model talked and operated valves, the tides rose and fell before the eyes of a spellbound audience.

Static exhibits of cement manufacturing; concrete tests, aggregates, and products; and standard testing equipment in the cement-testing laboratory were well displayed but aroused less interest than the standard briquet tension tests and cylinder compression tests. Considerable curiosity was also evidenced in a reinforced-brick research project being carried out by one of the faculty members.

Special care was given to publicity. Letters and announcements were sent to about 90 schools; announcements or articles were sent to appropriate Yale publications and general newspapers; a special tour of the exhibits was planned for reporters and camera men; two radio stations broadcast announcements; and *The Yale Scientific Magazine* contributed a full-page advertisement and ran a five-page pictorial section. In spite of bad driving conditions due to snow in the streets, there were about 2,200 visitors.

Two days of class cuts, requested by the committee with some trepidation, were voted by the faculty and proved to be more than justified. Although there was no requirement that students work in preparing the exhibits, they worked hard and gave generously of their time. The ability and confidence which they gained from facing a crowd of people and explaining in clear language a particular piece of apparatus were sufficient justification for the whole undertaking.

Richard L. Steiner, member of the Yale University Student Chapter, prepared an account of the exhibit for CIVIL ENGINEERING, of which this article is a summary.

Highway Safety Suggestions Included in Missouri Traffic Survey Report

"THE MOST HAZARDOUS class of driver is under 18 years of age," says the traffic survey report recently published by the Missouri State Highway Commission. But drivers, young or old, are blamed directly for less than half the automobile accidents in the state; the greater part of

the remainder are charged to "road condition factors."

The betterment of existing roads, says the report, has failed to keep pace with the increase in the speed of cars.

"Taking Missouri as an example, when the road program was first inaugurated motor vehicles were traveling at a maximum speed of about 35 miles an hour. The roads built at that time were designed accordingly. Many structures constructed by local subdivisions were taken into the state system and placed under maintenance. Consequently, narrow bridges and culverts, sharp curvature, poor horizontal and vertical sight distances, grade crossings, obsolete surfaces, etc., on roads subjected to excessive speed have contributed to traffic fatalities. In cities, hedges, fences, obstructions at street intersections, and other like agencies have caused the same results."

"Road hazards should be removed in the order of their importance. When an accident, especially more than one, occurs at a certain spot, then the hazard responsible for such an accident should be removed without delay."

The report also calls attention to the confusion arising from the non-uniformity and promiscuous use of traffic signs and signals.

"Not only the size, shape, color, and even wording thereon, but their location, especially at intersections, lack uniformity. Some folks are so constituted that searching for these various types of signs at every possible location and at the same time attending to their driving creates a nervous tension that often leads to an accident."

"At many intersections in several of the smaller cities the omission rather than the installation of traffic signals would result in less traffic confusion and, undoubtedly, less accidents. Signs and signals should be erected only where public safety necessitates, and promiscuous erection should be discouraged. In some places it has been found that a traffic signal actually increases accidents."

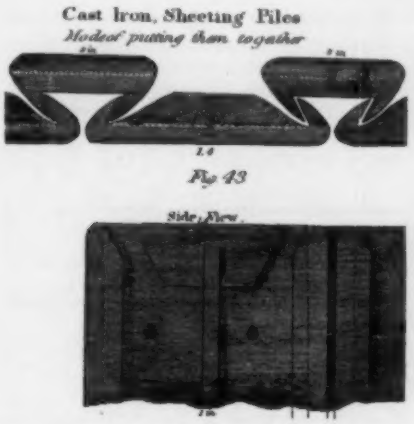
Sizes of Paving Brick

The permanent committee of the National Bureau of Standards on the simplification of varieties and sizes of vitrified paving brick has voted unanimously to propose to the industry a revision of simplified practice recommendation R1-35, which would eliminate the $2^1/_2$ by 4 by $8^1/_2$ and 3 by 4 by $8^1/_2$ sizes of plain wire-cut brick (vertical fiber lugless). Before the Department of Commerce can incorporate these proposed changes in a new edition of the printed recommendation, it is necessary that they be approved by the acceptors of the current simplified list of varieties. Therefore, all who are interested are now being circularized for the purpose of determining their wishes.

The Society has designated B. L. Crozier, M. Am. Soc. C.E., as its representative on the committee, to succeed the late R. Keith Compton, M. Am. Soc. C.E.

Brief Notes from Here and There

Interlocking metal sheet-piling was in use in England more than 100 years ago. The accompanying illustration is taken from a translation of Sganzin's *Elementary Course in Civil Engineering*, used as a text at West Point in 1827. The piles



were of cast iron, and alternated 8 and 17 in. in width. The maximum length of pile and the manner of driving are not mentioned, but the translator notes that with them cofferdams were built expeditiously and cheaply.

* * * *

A four-day conference on highway safety will be held at Iowa State College, June 29 to July 2, 1936. It will be open to the public, and is planned particularly for traffic officials, traffic managers of large fleets of trucks and cars, and the leaders and members of organizations interested in highway safety. The college has also announced a number of symposiums on highway safety, traffic control, transportation economics, and the coordination of transportation agencies, to be presented as a special feature of the graduate courses in highway engineering offered during the summer quarter. The symposiums will be presented by the regular teaching staff and by a staff of visiting lecturers who have achieved prominence in the various fields of study.

* * * *

The American Welding Society has just published its first specifications for the design, construction, alteration, and repair of highway and railway bridges by fusion welding. While the publication is in no sense a textbook, it includes some informatory material as a supplement to the mandatory clauses. The committee in charge of its preparation has recognized the need of further research, and suggests that such work may be stimulated by putting the new specifications promptly to the test of actual use. The publication, which has 66 pages and 19 illustrations, may be obtained from the American Welding Society, 33 West 39th Street, New York, N.Y., for the price of $1.00.

NEWS OF ENGINEERS

Personal Items About Society Members

Eric Fleming is now engineer for the National Park Service in Washington, D.C., for the 45 recreational demonstration projects in the United States in cooperation with the Land Utilization Division of the Resettlement Administration. Mr. Fleming was formerly administrative assistant for the National Park Service, supervising the work program of nine state park ECW (Emergency Conservation Work) camps in New Jersey.

Byram W. Steele, formerly designing engineer with the U. S. Bureau of Reclamation, was recently appointed chief design engineer for the Tennessee Valley Authority.

Harald M. Westergaard has been appointed Gordon McKay professor of civil engineering at Harvard University. He was previously professor of theoretical and applied mechanics at the University of Illinois.

Ole Singstad, chief consulting engineer on tunnels for the Port of New York Authority, has now been appointed chief engineer of the New York Tunnel Authority, in connection with a proposed tunnel under the East River. William McKenna Griffin will be assistant chief engineer on this project, and Jacob Mechanic will be chief construction engineer.

Willard T. Chevalier was installed as president of the American Road Builders' Association at the annual business meeting of this organization, which was held in Washington, D.C., on April 16 and 17.

James B. Hays, formerly with the U. S. Bureau of Reclamation in Denver, Colo., was recently appointed engineer in charge of construction of Chickamauga Dam by the Tennessee Valley Authority.

Thorndike Saville has been made dean of the College of Engineering of New York University. Professor Saville joined the staff of the university in 1932 in the capacity of professor of hydraulic and sanitary engineering. In May 1935 he became associate dean.

Victor J. Brown has accepted a position as publishing director of *Roads and Streets*. His address is in care of the Gillette Publishing Company, Chicago, Ill.

Robert L. Price is now an engineer apprentice with the Pennsylvania Railroad Company, having been assigned to the division engineer's office of this company in Cincinnati, Ohio. He was formerly an engineering draftsman for the Tennessee Valley Authority.

Robert E. Hiles is now resident engineer inspector for the Public Works Administration at Charleston, Ark., engaged on local water works and sewage disposal projects.

HOWARD F. PECKWORTH has resigned his position as field engineer for the Frederick Snare Corporation on the construction of the Tygart River dam near Grafton, W.Va., to become resident engineer for the Birmingham Industrial Water Supply Commission on the construction of a water-supply dam on the Blackburn Fork of the Warrior River. His headquarters are in Birmingham, Ala.

A. G. RIVES, who was formerly with the U. S. Forestry Service, is now an instrumentman in the Arkansas State Highway Commission, stationed at Fayetteville, Ark.

HENRY G. WILSON has taken a position as associate structural engineer in the procurement division of the U. S. Treasury in Washington, D.C. He was previously an assistant civil engineer in the construction division, Quartermaster's Corps, of the U. S. Army.

FRANK C. SELLNOW has resigned from the U. S. Forest Service to join the staff of Greeley and Hansen, consulting engineers of Chicago, who have been engaged by the Buffalo, N.Y., Sewer Authority to design and supervise the construction of an intercepting sewer and sewage treatment works. As soon as the work has been placed under contract, Mr. Sellnow will act as construction engineer.

ARTHUR B. MORRILL is now an associate civil engineer in the Detroit (Mich.) Department of Public Works, engaged on the design of the sewage disposal plant which the city will build during the next two years as a PWA project.

DUDLEY F. STEVENS, formerly with the U. S. Bureau of Biological Survey, has entered the employ of the Peninsula Paving Company, of San Francisco, Calif.

FREDERICK J. FRICKE is now employed by the Tennessee Valley Authority in the capacity of principal engineering draftsman. His headquarters are in Knoxville, Tenn. He was formerly in the U. S. Engineer Office at Tucumcari, N. Mex.

WILLIAM S. TRIMBLE, who was formerly sales engineer for W. C. Caye and Company of Knoxville, Tenn., has accepted a similar position with the Brooks-Payne-Osborne Equipment Company of the same city.

ARNOLD HOFMANN has taken a position with the U. S. Engineers as tunnel inspector on the diversion tunnels for the Fort Peck project. His headquarters are at Fort Peck, Mont.

FRANCIS MURRAY DAWSON, professor of hydraulic and sanitary engineering at the University of Wisconsin, has been appointed dean of engineering at the University of Iowa. He will take office on July 1, 1936. Pending this appointment, B. J. LAMBERT has been acting dean.

PERCY S. WILSON has joined the staff of the American Water Works Association in the capacity of acting secretary.

ALEXANDER GRAY was recently appointed chief engineer and manager of the Central Harbor Board of Canada.

DWIGHT F. ROBERTS has resigned as construction engineer for the Placentia (Calif.) School District to accept a position with the Smith Emery Company of Los Angeles, Calif., in charge of their physical testing department.

HOWARD A. SCHIRMER was recently appointed works engineer in charge of engineering for the fabricating works of the Bethlehem Steel Company at Alameda, Calif. He was previously resident engineer for the McClintic-Marshall Corporation in San Francisco.

DECEASED

ALBERT FARWELL BEMIS (Affiliate '16) of Boston, Mass., died on April 11, 1936, as the result of a fall that at the time did not seem serious. He was born in Boston on November 11, 1870, and graduated from the Massachusetts Institute of Technology in 1893. The major part of his career was spent with the Bemis Bro. Bag Company, of which he was president from 1909 to 1925 and chairman from 1925 until his retirement in 1934. He was a founder of the Angus Company, Ltd., operating a jute mill and machinery works in India. Mr. Bemis was noted for his generosity, his philanthropies including the rebuilding of the great tower of Lincoln Cathedral in England. He was the author of several books and numerous articles.

ALBIN HERMANN BEYER (M. '21) professor of civil engineering at Columbia University, died at Woodhaven, L.I., on April 19, 1936, at the age of 55. Professor Beyer, who was born in Germany, came to the United States in 1893. After graduating from Columbia University in 1903, he taught civil engineering at Cornell University. From 1909 to 1913 he was chief engineer for Alexander Potter, consulting engineer of New York City, on sanitation, hydraulics, and reinforced concrete construction. During the World War, Professor Beyer was assigned to the translation of German technical publications on aircraft and Diesel engines. In 1917 he joined the staff of Columbia University, becoming professor of civil engineering in 1920. Professor Beyer was nationally known as an expert in the design of reinforced concrete and had done considerable research on the deterioration of concrete under various conditions.

ROGER DERBY BLACK (M. '19) project engineer for the Public Works Administration on the Ward's Island sewage treatment plant in New York, died in that city on April 12, 1936, at the age of 53. Colonel Black was born at West Point, N.Y., and graduated from the U. S. Military Academy there in 1904. He passed through all grades of the army to the rank of major, and during the World War was attached to the general staff with the rank of colonel. In 1919 he resigned from the army and entered the field of private engineering. Colonel Black was with the Board of Transportation of New York on the construction of the independent subway system, and later was connected with the housing division of the Federal Emergency Administration of Public Works.

LEONARD JOHN BUTLER (Jun. '36) a civil engineer of San Mateo, Calif., died in April 1936, as the result of a fall off the slippery spillway at Gibraltar Dam (near Santa Barbara, Calif.). He had been sent from the government erosion control service headquarters near Oxnard to make silt tests. Mr. Butler, who was 23, was born at Flagstaff, Ariz. In 1935 he received the degree of B.S. C.E. from the University of Arizona.

HOWARD DOUGLAS CAMPBELL (Assoc. M. '20) assistant director of public safety for the city of Philadelphia, died in that city on May 6, 1936, at the age of 53. He was born in Philadelphia and graduated from Drexel Institute. From 1906 to 1911 he was an assistant engineer in the Philadelphia Bureau of Filtration, and from 1913 to 1918 he was in the Philadelphia Department of City Transit. From 1921 to 1932 he was secretary and treasurer of the Sutton Contracting Company of Philadelphia. In January 1936 he was appointed to the municipal post that he held at the time of his death.

JOHN HIRST CATON, 3D (M. '22) chief of the Division of Roads and Bridges in the Rhode Island Department of Public Works, died in Providence, R.I., on May 2, 1936. He was 52. Major Caton was born in Philadelphia, Pa., and educated at the Massachusetts Institute of Technology. He was regimental commander of the 33d Engineers, A.E.F. From 1908 to 1917 he was a construction engineer in the Manila (P.I.) Bureau of Public Works, and from 1920 to 1925 was director general of public works in the Republic of Santo Domingo. Later he was chief engineer for R. W. Hebard and Company, Inc., on contracts in Colombia and Salvador.

JOHN CARROLL CHASE (M. '93) treasurer of the Benjamin Chase Company of Derry, N.H., died in Boston, Mass., on April 15, 1936, at the age of 86. He was born in Chester, N.H., and graduated from the Massachusetts Institute of Technology in 1874. He was employed for a time on the construction of elevated railways in New York City. In 1881 he became superintendent of the Clarendon Water Works in Wilmington, N.C., where he remained until 1898. Mr. Chase spent the next seventeen years in water supply work in Georgia and the Carolinas, and in 1915 entered the manufacturing field at Derry, N.H.

WILLIAM DE LA BARRE (M. '93) for many years engineer, agent, and treasurer of the St. Anthony Falls Water Power

Company at Minneapolis, Minn., died in that city on March 24, 1936, at the age of 86. Mr. de la Barre's early experience included the design and erection of gas works plants and machinery for Boston, Washington, Harrisburg, Cincinnati, and numerous other cities. From 1879 to 1889 he was in full charge of the Washburn flour mills and elevator property. In 1889 he became connected with the St. Anthony's Falls Water Power Company and remained there for the rest of his life.

Henry Michael Dougherty (M. '22) an associate engineer in the Navy Department, died in Washington, D.C., on March 29, 1936. After graduating from the U. S. Military Academy in 1901, he served as a cavalry officer for two years. He then became associated with the J. G. White Engineering Company of New York, which placed him in charge of engineering projects in various parts of the United States and in Honolulu. For ten years Mr. Dougherty was chief engineer of the Chile Exploration Company at Chuquicamata, Chile, and spent several years on engineering work in South Africa. From June 1935 until the time of his death he did special work for the U. S. Navy Department.

Samuel Magee Green (Fellow '88) a well-known real estate operator and mining promoter, died at Oconomowoc, Wis., on April 25, 1936, at the age of 85. Mr. Green, who was a pioneer in the field of railroad construction, was the last but one of the surviving Fellows of the Society.

Elliot Holbrook (M. '02) a retired civil engineer, died in Kansas City, Mo., on March 20, 1936, at the age of 86. He was born in Rockland, Mass., and graduated from the Massachusetts Institute of Technology. Mr. Holbrook's entire career was devoted to railroad work. He was employed in various engineering capacities by a number of lines—among them the Pittsburgh and Lake Erie Railroad, the Baltimore and Ohio, the Kansas City Southern Railroad, the Missouri River and Gulf Railroad, the Harriman Line (of the Union Pacific system), the Burlington Railroad, and the Southern Pacific Lines. He was the author of several technical works.

Harry George Lee (Assoc. M. '15) president of the Standard Bitulithic Company of New York, died at his home in South Orange, N.J., on April 16, 1936, at the age of 49. Mr. Lee was born in East Orange, N.J., and graduated from Lafayette College in 1908. From 1909 to 1911 he was assistant city engineer of East Orange. In the latter year he joined the staff of the Standard Bitulithic Company, of which he later became president.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

Horace Sylvan Stansel (M. '32) civil engineer of Ruleville, Miss., died there on April 4, 1936. He was born at Columbus, Miss., on November 5, 1888. After graduating from Mississippi State College in 1914, he took up engineering work in Ruleville. From 1916 to 1922 he was engineer for the town of Ruleville and for Sunflower County, his work during this period including numerous street and highway improvements. From 1922 until his death he was engaged in private engineering practice. Mr. Stansel had been a member of the state legislature since 1923, and was recently elected speaker of the Mississippi House of Representatives. In late years he also served as state director for the Public Works Administration.

Charles Eugene Sudler (M. '13) assistant engineer for the Port of New York Authority, died in Bronxville, N.Y., on May 3, 1936, at the age of 59. He was born in Baltimore, Md. Mr. Sudler's early experience included construction engineering work on a number of projects—among them the erection of the Commodore Perry Memorial at Put-in-Bay, Lake Erie. For a number of years he maintained a consulting practice in New York City, and in 1935 joined the staff of the Port of New York Authority. In 1928 Mr. Sudler was awarded the Norman Medal of the Society for his paper on "Storage Required for the Regulation of Stream Flow."

Edward Ralph Taylor (Assoc. M. '28) died on June 4, 1935, at the age of 37. He was born in Trenton, N.J., and in 1918 graduated from Drexel Institute. In 1919 Mr. Taylor joined the staff of John A. Roebling's Sons Company of Trenton, N.J., where he continued in various engineering capacities. During the erection of cables for the Bear Mountain Bridge, the Philadelphia-Camden Bridge, and the George Washington Bridge, he served as field representative of that company.

Howard Flanders Taylor (M. '09) purchasing agent for the Kansas City Terminal Railway at Kansas City, Mo., died in that city on February 26, 1936. Mr. Taylor was born in Chelsea, Mass., in 1874. From the time of his graduation from the University of Kansas in 1895, Mr. Taylor was continuously engaged in railroad work. In 1909 he began his long career with the Kansas City Terminal Railway, serving successively as draftsman, secretary, and purchasing agent. In 1911 Mr. Taylor was in charge of the planning of the building and tracks of the Union Station in Kansas City.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From April 10 to May 9, 1936, Inclusive

Additions to Membership

Baker, Charles Duncan (Assoc. M. '36), County Surv., Clark County; City Engr., 115 South 4th St., Las Vegas, Nev.

Baughn, Charles Weaver (Jun. '36), Draftsman, State Highway Comm. (Res., 1012 West 6th St., Apartment D), Little Rock, Ark.

Besse, Irvin Kent (Jun. '36), 16 Schussler Rd., Worcester, Mass.

Brennan, Ambrose Francis (Jun. '35), Apprentice Eng. Draftsman, Eng. Service Div., TVA; Box 55, Brownville, N.Y.

Brooks, David Chase (Jun. '35), Care, U. S. Bureau of Public Roads, 1523 L St., N.W., Room 615, Washington, D.C.

Brown, Boyd Scott (Jun. '36), Care, Braden Copper Co., Rancagua, Chile.

Cahalan, William James (Jun. '35), 70 Eastwood St., East Orange, N.J.

Clark, James Gordon (Jun. '35), 440 Custom House, Denver, Colo.

Cullen, William Patrick (Jun. '35), 1722 North Broad St., New Orleans, La.

Darnall, William Henry, Jr., (Jun. '36), Insp., Class III, State Road Comm., Princeton, W.Va.

DesRochers, Raymond George (Jun. '35), 44 Providence St., Aldenville, Mass.

Eberhart, Howard Davis (Jun. '36), Prin. Draftsman, Bonneville Section, U. S. Engrs. (Res., 2235 South West Vista Ave.), Portland, Ore.

Englund, Oscar Edmund (Jun. '35), 1489 Van Buren St., St. Paul, Minn.

Enns, Everett Byron (Jun. '35), 1002 Beltrami Ave., Bemidji, Minn.

Farrell, Joseph Romulus (Assoc. M. '36), Engr. and Contr., 21 South 46th St., Philadelphia, Pa.

Gearhart, John Chase (Jun. '35), Draftsman, Office of State Engr., Salem (Res., 404 South East 68th Ave., Portland), Ore.

Groner, David (Jun. '36), Senior Foreman,

CCC Camp S. P. 44, 119 Auburn St., Ithaca, N.Y.

HAASE, ROBERT RALPH (Jun. '36), 403 Baronne St., New Orleans, La.

HARRIS, MILLARD HENRY (Jun. '36), 1637 Massachusetts Ave., N.W., Washington, D.C.

HEARD, GARLAND WILSON (Jun. '36), County Engr., Tippah County Board of Supervisors, Box 151, Ripley, Miss.

HEDDING, JOSEPH ALBURTUS (Jun. '35), 312 South German St., New Ulm, Minn.

HORWITZ, SOLOMON (Assoc. M. '36), Chf. Engr., West End Iron Works, Cambridge (Res., 6 Perkins Manor, Jamaica Plain), Mass.

JENKINS, EDWARD MAGILL (Assoc. M. '36), Vice-Pres., Selective Presidential Constr., Inc., 28 Waverly Ave., Mamaroneck (Res., 5 Rutgers Pl., Scarsdale), N.Y.

KELLY, MELVIN CAMPBELL (Assoc. M. '36), Engr. and Officer, Dist. Impvt. Corporation and Great Lakes Concrete Pipe Co., Inc.; Pres., Northeastern Concrete Pipe Assoc., Buffalo (Res., 87 Audubon Drive, Snyder), N.Y.

KRUSE, CORNELIUS WOLFRAM (Jun. '36), Care, Health and Sanitation Section, TVA, Iuka, Miss.

LAMBERT, ARTHUR VICTOR (Assoc. M. '36), Engr., Dept. of Purchase, City of New York, 344 Hudson St. (Res., 440 East 138th St.), New York, N.Y.

LINDSEY, HARRY MALVERN, JR. (Jun. '35), Care, U. S. Geological Survey, Camp Verde, Ariz.

LYONS, PERCY FELIX (Assoc. M. '36), Examiner, WPA, Dist. 4 (Res., 3206 Knight St.), Dallas, Tex.

MACMURRAY, LLOYD CHARLES (Jun. '35), Ellicott City, Md.

MAMBELLI, EMIL SELEPHONO (Assoc. M. '36), Junior Civ. Engr., Dept. of Water and Power, City of Los Angeles (Res., 5703 Victoria Ave.), Los Angeles, Calif.

MCDOWELL, ROBERT CHARLES (Jun. '35), 1975 West Grand Boulevard, Detroit, Mich.

MCNAIRY, WYATT HAMILTON (Jun. '35), Student Apprentice, So. Ry. (Res., 612 Gales Ave.), Winston-Salem, N.C.

MENGERINK, CECIL ENGBERT (Jun. '35), 704 West Washington St., Napoleon, Ohio.

MEYBURG, GUSTAV (Jun. '36), Engr. Asst., Dept. of Docks (Res., 2004 Clinton Ave.), New York, N.Y.

MORRISON, WILLIAM WOODROW (Jun. '35), 1637 Webster St., N.W., Washington, D.C.

NELSON, GEORGE AUGUSTUS (Assoc. M. '36), Director of Reconditioning, HOLC, Washington, D.C. (Res., 2336 University Ave., New York, N.Y.).

NIZENKOFF, CONSTANTIN CONSTANTINOVICH (Jun. '35), 4123 Eleventh Ave., N.E., Seattle, Wash.

RICHARDS, IVAN FORD (Jun. '35), With Bureau of Reclamation (Res., Y.M.C.A., Room 502), Denver, Colo.

RIGGS, CHARLES EDWARD (Jun. '36), Field Engr., Joint State Highway Dist. 13, 5420 Bryant Ave., Oakland, Calif.

ROGERS, FRANKLYN CHRISTOPHER (Jun. '36), Draftsman-Designer, Ambursen Dam Co., 295 Madison Ave., New York, N.Y. (Res., Columbus Ave., Harrington Park, N.J.)

SCHMIDT, HUGO HENRY (Jun. '36), Draftsmen, State Bureau of Roads and Irrig., Box 312, Orleans, Nebr.

SHULTZ, ROBERT JOHN (Jun. '36), Eng. Draftsman, TVA (Res., 701 Battery Pl.), Chattanooga, Tenn.

SIMPSON, WALTER LINTON (M. '36), Senior Regional Engr., RA (Res., Hotel Powhatan), Washington, D.C.

SPOHN, ARTHUR EDWARD (Jun. '35), 19 St. Lukes Pl., Montclair, N.J.

TOWNSEND, GEORGE ELLSWORTH (Jun. '36), Asst. Eng. Draftsman, TVA (Res., 313 Lindsay St., Apartment 11), Chattanooga, Tenn.

TYLER, JACK HENNIGAN (Jun. '35), Laboratory Asst., Los Angeles County Flood Control Dist. (Res., 7259 Jordan Ave.). Canoga Park, Calif.

VACCARO, GEORGE (Jun. '36), Draftsman, Madigan & Hyland, 521 Fifth Ave., New York (Res., 335 Humboldt St., Brooklyn), N.Y.

WARWICK, PUTNAM RAND (Jun. '35), Warrenton, Ga.

WILLIAMS, CHARLES HARVEY (M. '36), City Engr. and Water Supt. (Res., 826 Percival St.), Olympia, Wash.

WILSON, HARRY LANTZ (M. '36) Prin. Asst. Project Engr., PWA, Minneapolis-St. Paul San. Dist. Project (Res., 3634 Forty-seventh Ave., South), Minneapolis, Minn.

MEMBERSHIP TRANSFERS

ADAMS, RAY (Jun. '27; Assoc. M. '36), Designer, Bureau of Bridges, State Highway Comm. (Res., 1715 West McCarty St.), Jefferson City, Mo.

BITNER, MELVILLE SPERRY (Jun. '28; Assoc. M. '36), Asst. Engr., Bureau of Reclamation, 432 U. S. Customhouse (Res., 1350 Sherman St.), Denver, Colo.

BRAISTED, WILLIAM ADELBERT (Jun. '26; Assoc. M. '36), Village Engr. and Street Commr. (Res., 120 Elm St.), Bennington, Vt.

CARLTON, WILLIAM WALTER (Assoc. M. '28; M. '36), Senior Asst. Structural Engr., Dept. of Buildings, City Hall, Cincinnati, Ohio.

COON, EMMETT JOHN (Jun. '31; Assoc. M. '36) Asst. Topographic Engr., U. S. Geological Survey, Box 346, Sacramento, Calif.

DENNETT, ROBERT CLARK (Assoc. M. '19; M. '36), Office Engr., National Board of Fire Underwriters, 85 John St., New York, N.Y.

FREESE, SIMON WILKE (Jun. '22; Assoc. M. '26; M. '36), Cons. Engr. (Hawley, Freese & Nichols), 407 Capps Bldg., Fort Worth, Tex.

HAWES, LORIN LINDLEY (Jun. '34; Assoc. M. '36), Asst. Hydr. Engr., Hydr. Div., Elec. Dept., Braden Copper Co., Coya, Rancagua, Chile.

HUBBARD, WINFRED DEAN (Assoc. M. '02; M. '36), Div. Engr., Dept. of Water Supply, Gas and Electricity, City of New York, 145 Pearl St., Kingston, N.Y.

KEENE, PHILIP (Jun. '29; Assoc. M. '35), Senior Technical Clerk, Inspection Div., PWA, Interior Bldg. (Res., 1310 Nineteenth St., N.W.), Washington, D.C.

KLEIN, MICHAEL (Jun. '32; Assoc. M. '35), Senior Engr., Dept. of Parks (Res., 88 Second Ave.), New York, N.Y.

TOTAL MEMBERSHIP AS OF MAY 9, 1936

Members	5,708
Associate Members	6,191
Corporate Members	11,899
Honorary Members	19
Juniors	3,226
Affiliates	94
Fellows	1
Total	15,239

KNAPPEN, THEODORE TEMPLE (Jun. '28; Assoc. M. '29; M. '36), Senior Engr., Chf., Eng. Div., U. S. Engr. Office, Zanesville Engr. Dist., (Res., 1968 Dresden Rd.), Zanesville, Ohio.

MALONY, WALDEN LEROY (Jun. '09; Assoc. M. '13; M. '36), Superv. Engr., Building Constr. and Structural Designing, State Coll. of Washington (Res., 200 Spaulding St.), Pullman, Wash.

MICKLE, DAVID GRANT (Jun. '30; Assoc. M. '36), Asst. Director, in Chg. Traffic, State Highway Planning Survey; Traffic Engr., Jensen, Bowen & Farrell, 209 Michigan Theatre Bldg., Ann Arbor, Mich.

MORELAND, JAMES BROWN (Jun. '25; Assoc. M. '35), With U. S. Coast and Geodetic Survey (Res., 410 West 110th St.), New York, N.Y.

MORGAN, CHARLES EDWARD (Assoc. M. '30; M. '36), Design Engr., Bureau of Bridges, State Div. of Highways, 414 Centennial Bldg. (Res., 2215 East Capitol Ave.), Springfield, Ill.

NEUMAN, DAVID LEONARD (Jun. '14; Assoc. M. '20; M. '36), Maj., Corps of Engrs., U.S.A., U. S. Engr. Office (Res., 4303 Kensington Ave.), Richmond, Va.

OLMSTEAD, CHARLES HAROLD (Assoc. M. '21; M. '36), Cons. Engr., The Barrett Co., Chicago (Res., 317 Seventh Ave., South, La Grange), Ill.

PRIOR, CHARLES HENRY (Jun. '31; Assoc. M. '36), Asst. Hydr. Engr., U. S. Geological Survey, Box 821, Fayetteville, Tenn.

RANDIG, WESLEY HERBERT (Jun. '31; Assoc. M. '35), Lieut. (jg), C. E. C., U.S.N., Maintenance Supt., U. S. Navy Yard, Cavite, Philippine Islands.

ROBERTS, EMORY DOUGLAS (Assoc. M. '21; M. '36), Prof. and Head of Dept., Civ. Eng., Marquette Univ., 1210 West Michigan St., Milwaukee, Wis.

TAYLOR, HENRY WILLIAM (Assoc. M. '13; M. '36), Cons. Engr., 11 Park Pl., New York, N.Y.

THOMAS, MILES HARRISON (Jun. '27; Assoc. M. '36), Junior Engr., U. S. Engr. Office, Rock Island, Ill.

TOLANDER, ARTHUR WILLIAM (Jun. '26; Assoc. M. '36), Engr., Standard Oil Co. of Venezuela, Caripito, Venezuela.

VOIGT, PAUL ALEXANDER (Jun. '28; Assoc. M. '36), Asst. to Chf. Engr., Building Materials Dept., Johns-Manville Corporation, 22 East 40th St., New York (Res., 7748 Seventy-Eighth St., Glendale), N.Y.

WEIL, HERBERT LOUIS (Jun. '26; Assoc. M. '36), Asst. Engr., U. S. Engr. Laboratory (Res., 526 Cheyenne St.), Fort Peck, Mont.

WYLLIE, GEORGE FAIR (Jun. '27; Assoc. M. '36), Engr., Shoecraft, Drury & McNamee, Ann Arbor (Res., 411 North Saginaw St., Durand), Mich.

REINSTATEMENTS

DAY, CHARLES GOODWIN, Jun., reinstated April 24, 1936.

FISHER, WILLIAM, Jun., reinstated April 16, 1936.

STAPLES, LEROY AUGUSTUS, Assoc. M., reinstated April 21, 1936.

RESIGNATIONS

CHANDLER, JERMAIN, Assoc. M., resigned April 24, 1936.

LANE, THOMAS ALPHONSUS, Jun., resigned April 28, 1936.

WALTON, EDWARD HAVILAND, Jun., resigned April 28, 1936.

WILLIAMSON, ORA KILBURN, M., resigned May 7, 1936.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

June 1, 1936 NUMBER 6

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

Grade	General Requirement	Age	Length of Active Practice	Responsible Charge of Work
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years †	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.

† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

ADMISSIONS

Acton, Joseph Paul, White Plains, N.Y. (Age 27.) Senior Engr., WPA, Bear Mountain Park, Iona Island, N.Y. Refers to F. A. Barnes, J. E. Perry, C. W. Van Dyke, W. F. von Buehren.

Baker, Wilfred Harmon, Rutland, Vt. (Age 24.) Chf. Surveyor Draftsman, U. S. Forest Service. Refers to E. F. Berry, E. F. Church, L. Mitchell, S. D. Sarason.

Barber, Richard Lewis, Westerly, R.I. (Age 30.) In private practice of engineering and highway design and construction; also Cons. Engr., Westerly Highway Comm. Refers to D. O. Cargill, J. H. Caton, 3d., H. W. Congdon, G. H. Henderson, M. A. Lippman.

Barfoot, Joseph Earl, Seattle, Wash. (Age 24.) Refers to C. C. More, F. H. Rhodes, Jr., R. B. Van Horn.

Barte, George Russell, Iowa City, Iowa. (Age 33.) Inspector and Draftsman, War Dept. Refers to H. M. Hill, E. W. Lane, F. T. Mavis, C. H. Paul, D. L. Yarnell.

Calvert, Cecil Kirk, Indianapolis, Ind. (Age 49.) Refers to R. A. Allton, H. E. Babbitt, E. Bartow, C. Brossman, F. M. Dawson, W. Donaldson, H. O. Garman, S. A. Greeley, C. H. Hurd, A. B. Morrill, H. S. Morse, L. Pearse, W. Rudolfs, F. H. Waring, R. B. Wiley.

Cervino, William Nicholas, Paterson, N.J. (Age 32.) Senior Engr. with WPA, in charge of road construction project, West Milford, N.J. Refers to C. D. Geiger, S. E. Greydanus, M. Hendee, J. A. Ward, F. J. Wright.

Clark, George John, Shamokin, Pa. (Age 25.) Transitman, Philadelphia & Reading Coal & Iron Co., Ashland, Pa. Refers to E. R. Cary, L. W. Clark, H. B. Compton, T. R. Lawson, H. O. Sharp.

Cochran, Albert Ludwell, Kansas City, Mo. (Age 28.) Jun. Engr., Hydrology Sec., U. S. Engr. Office. Refers to J. P. Edstrand, G. A. Hathaway, D. H. McCoskey, H. K. Shane, W. R. Spencer.

Dammeyer, Everett Earl, West Lafayette, Ind. (Age 32.) Senior Engr., State Highway Comm. of Indiana. Refers to C. A. Ellis, F. Kellam, W. A. Knapp, G. G. Wickline, R. B. Wiley.

Dewey, Haywood Guion, Jr., Denver, Colo. (Age 23.) Jun. Engr., Bureau of Reclamation. Refers to F. A. Barnes, S. C. Hollister, J. E. Perry, F. J. Seery, J. E. Warnock.

Dirzulaitis, Joseph James, University, Va. (Age 42.) Senior Hydraulic Engr., Water Resources Branch, U. S. Geological Survey. Refers to J. A. Anderson, N. C. Grover, A. W. Harrington, O. W. Hartwell, A. H. Horton, J. C. Hoyt, C. G. Paulsen.

Dye, Forrest Leslie, Jr., Memphis, Tenn. (Age 29.) With Dredging Sec., U. S. Engr. Office. Refers to H. S. Gladfelter, L. L. Hidinger, H. Kramer, F. I. Louckes, J. W. Pumphrey, C. H. Schwartz.

Fetters, Howard Frederick, Ann Arbor, Mich. (Age 26.) Draftsman, Durand Airship Comm. Refers to W. C. Hoad, L. C. Maugh, R. H. Sherlock.

Foster, Christopher Jerome, Grafton, W.Va. (Age 27.) Civ. Engr. with Frederick Snare Corporation. Refers to E. R. Akers, J. Barnett, T. F. Davey, A. G. Hayden, R. M. Hodges, P. H. Lovering.

Friend, Philip Stearns, Princeton, N.J. (Age 30.) Computer, U. S. Coast & Geodetic Survey of New Jersey. Refers to J. L. Bauer, W. G. Clark, J. F. W. Gebhardt, P. Kissam, E. Pendlebury.

Gregory, George Arthur, Olympia, Wash. (Age 42.) Res. Engr. Inspector, PWA. Refers to O. A. Anderson, C. J. Bartholet, F. H. Craddock, V. Gongwer, R. K. Tiffany.

Hickey, John Howard, Roselle Park, N.J. (Age 38.) Engr., Distribution Dept., Elizabethtown Consolidated Gas Co., Elizabeth, N.J. Refers to R. M. Beck, T. E. Collins, J. W. Higgins, F. Hudson, Jr., G. M. Kilcarr, C. L. Specht, P. L. Voss.

Hopkins, Martin Francis, Charleston, W.Va. (Age 38.) Senior Structural Engr., Public Service Comm. of West Virginia. Refers to H. M. Buck, W. H. Crawford, C. A. Duncan, W. E. Hamilton, E. H. Morris.

Hurlow, Hugh, Jr., Tacoma, Wash. (Age 41.) Dist. Mgr., American Cable Co. and Hazard Wire Rope Co. Refers to H. O. Blair, R. W. Finke, H. H. Gilbert, L. S. Moisseiff, G. L. Parker, W. J. Ryan, B. P. Thomas.

Hyder, Kenneth Lee, Milwaukee, Wis. (Age 48.) Asst. Vice-Pres., The American Appraisal Co. Refers to L. R. Howson, H. D. Loring, P. H. McDonald, A. Marston, W. L. Prouty, E. F. Wendt.

Jansen, Jacques, New York City. (Age 39.) Engr. of Constr., City of New York and U. S. Works Administration. Refers to H. C. Ford, E. A. Groves, C. M. Knez, D. W. Krellwitz, A. T. Moran, P. J. Moranti.

Jones, Malcolm Halley, Galveston, Tex. (Age 24.) Jun. Engr., U. S. Engr. Office. Refers to S. Jens, E. O. Sweetser, J. G. Tripp.

Kartzke, Paul Louis, Pasadena, Calif. (Age 23.) Jun. Engr., Shell Oil Co. Refers to R. R. Martel, F. Thomas.

Lancaster, Kenneth George, Junction City, Kans. (Age 26.) Jun. Plans Draftsman, Kansas State Highway Comm. Refers to L. E. Conrad, O. J. Eidmann, F. W. Epps, L. Grover, J. A. Roby.

Lemonds, Donald Arthur, Seattle, Wash. (Age 24.) Refers to G. E. Hawthorn, C. C. More, O. A. Piper, F. H. Rhodes, Jr., R. G. Tyler.

Ley, Robert Tait, Springfield, Mass. (Age 23.) Engr., Fred T. Ley & Cia., S.A., Bogota, Colombia. Refers to F. W. Garran, H. H. Hatch, W. P. Kimball, E. E. Lochridge, R. R. Marsden.

Lunt, Randle Gibson, Los Angeles, Calif. (Age 32.) Senior Draftsman with Los Angeles County Surveyor. Refers to C. E. Arnold, W. T. Evans, A. Jones, O. D. Keese, C. B. Long, T. I. Phelps, F. W. Pore.

Luthin, John Christopher, Berkeley, Calif. (Age 25.) With Inspection Dept., East Bay Municipal Utility Dist., Oakland, Calif. Refers to J. D. DeCosta, H. F. Gray, C. G. Hyde.

McCaughan, Frank Allan, Dallas, Tex. (Age 29.) Inspector and Engr. with Myers, Noyes & Forrest. Refers to T. C. Forrest, Jr., C. Manes, E. L. Myers, E. N. Noyes, R. B. Thomas.

Mickey, James Daniel, Ogallala, Nebr. (Age 23.) With R. O. Green as Office Engr. on Keystone Dam, C.N.P.P. and I.D. Refers to G. N. Carter, F. T. Darrow, H. J. Kesner, C. E. Mickey.

MILLER, ALFRED LAWRENCE, Seattle, Wash. (Age 38.) Associate Prof., Coll. of Eng., Univ. of Washington. Refers to C. W. Harris, G. E. Hawthorn, W. J. Howard, C. C. May, C. C. More, F. H. Rhodes, Jr., R. B. Van Horn.

MOHLER, FRANKLIN CALVIN, Ottumwa, Iowa. (Age 28.) Jun. Engr., Soil Conservation Service, U. S. Dept. of Agriculture. Refers to J. S. Dodds, A. H. Fuller, W. E. Galligan, L. O. Stewart.

MORANG, CLARENCE NOLAN, Iowa City, Iowa. (Age 28.) Jun. Engr., U. S. Engr. Office. Refers to R. G. Kasel, F. T. Mavis, D. L. Yarnell.

MORTON, DONALD ROSS, JR., Wilmington, Del. (Age 25.) Rodman, E. I. du Pont Co. Refers to J. L. Harrington, H. K. Preston.

MURRAY, ANGUS NORMAN, Rice, Calif. (Age 23.) Inspector, Metropolitan Water Dist. of Southern California. Refers to H. E. Phelps, M. K. Snyder, W. E. Whittier.

MURRAY, MORRIS LUTHER, JR., Little Rock, Ark. (Age 28.) Highway Designer, Arkansas State Highway Dept. Refers to W. E. Ford, G. L. Fry, A. W. Hardy, M. W. Kehart, H. M. Wright, W. W. Zass.

NUNN, HENRY EDWIN, Van Buren, Ark. (Age 42.) Supt., Water Works Improvement Dist. No. 1. Refers to L. H. Enslow, E. L. Filby, J. H. Gardiner, W. R. Holway, W. R. Spencer, W. L. Winters, C. A. Young.

O'BRIEN, FRED ENNIS, Watertown, N.Y. (Age 47.) City Engr., and Adviser to Dept. of Public Works. Refers to J. W. Ackerman, J. P. Burns, E. S. Cullings, W. H. Cushman, W. T. Field, R. F. Hall, A. W. Harrington.

ORLAND, HERBERT PAUL, Canton, Mass. (Age 22.) Jun. Civ. Engr., Lackawanna Steel Constr. Corporation, Buffalo, N.Y. Refers to E. N. Burrows, S. C. Hollister, T. Human, Jr., J. E. Perry, F. J. Spry, R. Y. Thatcher, C. L. Walker.

ORR, JOSEPH ANDERSON, College Station, Tex. (Age 35.) Associate Prof., Agricultural and Mechanical Coll. of Texas. Refers to F. E. Giesecke, L. E. Grinter, J. J. Ledbetter, Jr., T. A. Munson, J. J. Richey, C. E. Sandstedt.

OWEN, MARK BLYNN, Dearborn, Mich. (Age 41.) Vice-Pres. and Director, Nichols Eng. & Research Corporation, New York City. Refers to L. H. Enslow, M. R. Fisher, C. W. Hubbell, A. H. Place, A. Roth, F. R. Storrer, S. I. Zack.

PETERSEN, HARRY GEORGE, San Leandro, Calif. (Age 25.) Concrete Technologist, Golden Gate Atlas Materials Co., San Francisco, Calif. Refers to E. L. Grant, C. D. Marx, L. B. Reynolds, E. C. Thomas, J. B. Wells.

PETERSON, LAWRENCE KENNETH, Sacramento, Calif. (Age 29.) Jun. Topographic Engr., U. S. Geological Survey. Refers to L. L. Bryan, H. H. Hodgeson, R. R. Monbeck, E. D. Roberts.

PICKERING, OKIE LEE, Bristol, Tenn. (Age 36.) Res. Engr. Inspector, PWA. Refers to W. P. Darwin, R. D. Gladding, C. W. Haasis, K. W. Markwell, R. L. Morrison, R. B. Newman, Jr., J. E. Van Trees, Jr., W. H. Wilson.

PRAUGHT, CLARENCE HAROLD, Red Lake, Minn. (Age 28.) Jun. Engr., U. S. Indian Forestry Service. Refers to G. W. Bradshaw, D. D. Haines, W. C. McNown.

PRENTICE, THOMAS HAROLD, New York City. (Age 42.) Instructor in Civ. Eng., Coll. of City of New York. Refers to H. Abbott, B. A. Bakhmeteff, R. V. Banta, R. W. Boyd, F. O. X. McLoughlin, C. H. Schwertner, A. W. Stephens.

RICHTER, VICTOR JOHN, Washington, D.C. (Age 32.) Associate Agricultural Engr., U. S. Dept. of Agriculture, Soil Erosion Control Investigations, Soil Conservation Service. Refers to H. L. Cook, B. J. Lambert, H. R. Leach, F. T. Mavis, C. C. Williams.

RIKRDON, DEWEY JAMES, Phoenix, Ariz. (Age 37.) Dist. Highway Engr., U. S. Indian Service, Dept. of Interior. Refers to N. B. Conway, H. J. Doolittle, F. D. Hartford, H. C. Neuffer, R. H. A. Rupkey, A. N. Thompson.

RUPP, CARL FREDERICK, Union City, N.J. (Age 25.) Engr., WPA. Refers to C. H. Gronquist, H. N. Lendall.

RYAN, ALFRED JOSEPH, Denver, Colo. (Age 27.) Draftsman, Moffat Tunnel Diversion Project, H. S. Crocker, Cons. Engr. Refers to H. S. Crocker, R. L. Downing, C. L. Eckel, C. H. Knoettge, J. W. McCullough, E. H. Schneider, R. J. Tipton.

SHEPARD, CHARLES HAROLD, Columbus, Ohio. (Age 24.) Laboratory Technician, Soil Sec., Ohio State Highway Testing Laboratory. Refers to R. R. Litehiser, R. C. Sloane.

SMITH, CHARLES HENRY, Portland, Ore. (Age 67.) Sewer Engr., Dept. of Public Works. Refers to J. W. Cunningham, R. G. Dieck, F. T. Fowler, C. E. Green, G. Kimbrell, H. E. Newell, O. E. Stanley.

SMITH, JOSEPH WILLIAM, Grand Haven, Mich. (Age 23.) Refers to L. M. Gram, R. H. Sherlock.

STACK, WILLIAM, Chicago, Ill. (Age 39.) Engr.-Inspector, Chicago Testing Laboratory on paving project at Moline, Ill. Refers to C. N. Bainbridge, J. B. Black, C. A. Case, A. W. Consoer, G. O. Consoer, S. A. Greeley, R. G. Kasel, B. H. Platt, G. R. Scott.

STREATER, SHELTON HAROLD, Cache, Okla. (Age 32.) ECW Supt., U. S. Forest Service and U. S. Biological Survey. Refers to J. L. Brownlee, J. C. Carpenter, R. C. Gowdy, M. C. Hinderlider, C. M. Lightburn, A. O. Ridgway.

WATERBURY, LAWRENCE STUART, New York City. (Age 39.) In private practice and on special assignments as Civ. Engr. and Supt. Refers to J. H. Gaynor, F. A. Holby, C. A. Latimer, E. D. Lynch, W. K. Peasley, H. R. Standiford, L. S. Stiles, E. M. Van Norden.

WEST, GEORGE GOODSON, Portland, Ore. (Age 36.) Chf., Hydrology Sec., U. S. Engrs., 2nd Portland Dist. (Bonneville Dam); Capt., Coast Artillery Corps. Refers to S. De Moss, A. J. Gilardi, J. Jacobs, F. E. Leefe, B. L. Peterson, S. H. Sims, J. C. Stevens, J. R. West.

WILLIAMS, GORDON LEE, Denver, Colo. (Age 25.) Jun. Engr., U. S. Bureau of Reclamation, Dam Design Dept., on design of Grand Coulee Dam. Refers to J. M. Boyd, J. J. Hammond, T. M. Lowe, P. L. Reed, W. L. Sawyer, C. A. Schanck, H. W. Tabor.

WILSON, CARL AMOS, Kansas City, Kans. (Age 34.) Asst. County Engr., Wyandotte County, Kans. Refers to L. Arnold, E. Boyce, D. D. Haines, C. E. Jacoby, J. O. Jones, W. C. McNown, F. A. Russell.

WISELY, WILLIAM HOMER, Springfield, Ill. (Age 29.) Asst. San. Engr., Illinois State Dept. of Public Health. Refers to H. E. Babbitt, A. W. Consoer, M. L. Enger, J. A. Harman, H. A. Spafford, A. C. Stanfield, J. J. Woltmann.

WOOD, DAVID BAKER, Maysville, Ky. (Age 32.) In private practice. Refers to F. W. Ely, B. J. Fletcher, J. P. Growdon, J. B. Hays, B. S. Philbrick, J. W. Rickey, C. H. Sutherland.

WOOD, HORACE WALTER, JR., Columbia, Mo. (Age 42.) Associate Prof. and Chairman, Dept. of Mechanics, Univ. of Missouri; also Chf. Engr., Current River Power Co. and Gasconade River Power Co. Refers to C. W. Brown, A. L. Hyde, E. J. McCaustland, R. B. B. Moorman, H. K. Rubey.

YOUNG, GUY RAYMOND, Detroit, Mich. (Age 30.) Detailer and Designer, Eng. Dept., Detroit Rock Salt Co. Refers to J. J. Dunkel, C. C. Johnston, J. L. Mann, C. J. J. Pajot, L. C. Wilcoxen.

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

BECK, PAUL LEO, Assoc. M., San Francisco, Calif. (Elected Nov. 15, 1926.) (Age 43.) Valuation and Rate Engr., City of San Francisco. Refers to A. J. Cleary, N. A. Eckart, N. R. Ellis, L. T. McAfee, G. W. Pracy.

DAVIS, PHILIP KEES, Assoc. M., Oakland, Calif. (Elected July 14, 1930.) (Age 37.) Constr. Engr., 13th Highway Dist., State of California. Refers to W. B. Boggs, M. C. Collins, A. S. Gelston, H. F. Miter, D. R. Warren.

FURR, MANFORD W., Assoc. M., Manhattan, Kans. (Elected Jan. 15, 1923.) (Age 47.) Prof. of Civ. Eng., Kansas State Coll. Refers to T. R. Agg, W. E. Baldry, L. E. Conrad, F. W. Epps, F. F. Frazier, G. S. Knapp, W. A. Knapp, F. A. Russell, R. B. Wiley.

GAUTHIER, PAUL GILLES, Assoc. M., Outremont, Quebec, Canada. (Elected Junior Jan. 14, 1924; Assoc. M. April 22, 1929.) (Age 36.) Townsite Engr., Ontario Paper Co. Refers to O. B. Bestor, F. H. Cothran, R. DeL. French, O. O. Lefebvre, D. F. Noyes, R. White.

IRVIN, RICHARD, Assoc. M., Pittsburgh, Pa. (Elected Junior Sept. 6, 1910; Assoc. M. Dec. 6, 1915.) (Age 51.) Registered Archt. and Professional Engr. Refers to L. P. Blum, J. O. Cook, N. F. Hopkins, R. Khuen, Jr., N. Schein, T. J. Wilkerson.

LAND, RICHARD IRVING, Assoc. M., Mamaroneck, N.Y. (Elected Junior June 6, 1927; Assoc. M. Oct. 14, 1932.) (Age 35.) Asst. to Purchasing Agt. and Contr. Mgr., Marc Eidlitz & Son, New York City. Refers to F. A. Barnes, F. A. Ciampa, F. W. Gardiner, H. T. Larsen, R. A. McCulloch, R. H. Mann, G. H. Pegram, L. C. Urquhart, C. L. Walker, D. T. Webster.

MARSON, HOMER ROBERTS, Assoc. M., Detroit, Mich. (Elected Jan. 19, 1925.) (Age 43.) With Budget Bureau, City Controller's Office. Refers to P. A. Fellows, G. H. Fenkell, M. R. Fisher, F. N. Menefee, A. B. Morrill, F. H. Stephenson, H. F. Vaughan, M. F. Wagnitz, F. E. Weber, L. C. Wilcoxen.

SALTER, GEORGE STAUFFER, Assoc. M., Chicago, Ill. (Elected Junior Oct. 15, 1923; Assoc. M. July 16, 1928.) (Age 39.) Structural Designer and Senior Squad Leader, San. Dist. of Chicago. Refers to N. E. Anderson, L. B. Barker, J. R. Hall, H. P. Ramey, H. S. Ripley, A. N. Wardle, L. C. Whittemore.

THACKWELL, HENRY LAWRENCE, Assoc. M., Longview, Tex. (Elected Junior Dec. 3, 1912; Assoc. M. Nov. 28, 1916.) (Age 47.) Cons. Engr. Refers to J. E. Field, R. Follansbee, M. C. Hinderlider, S. C. Hulse, J. Jacobs, E. L. Myers, E. N. Noyes, R. A. Thompson, F. F. Weld.

WHEELER, RALPH NORMAN, Assoc. M., Cocoa, Fla. (Elected Jan. 7, 1903.) (Age 62.) Refers to W. W. Brush, S. K. Clapp, W. D. Hubbard, T. Merriman, R. Ridgway, J. F. Sanborn, W. E. Swift.

WOOD, ROBERT WALTER, Assoc. M., West New Brighton, N.Y. (Elected Junior April 30, 1907; Assoc. M. Nov. 8, 1909.) (Age 54.) Engr., Eng. Bureau, Richmond Borough, New York City. Refers to O. L. Brodie, J. T. Fetherston, W. R. Hillyer, A. K. Johnson, T. S. Oxholm, V. H. Reichelt, C. E. Trout.

FROM THE GRADE OF JUNIOR

CALDWELL, WILLIAM METZ, Jun., Jersey City, N.J. (Elected Dec. 5, 1927.) (Age 33.) Instructor, Pratt Inst., Brooklyn, N.Y. Refers to C. Cruse, A. W. Green, Jr., P. Kissam, R. O'Donnell, B. Rasmussen.

DAY, CHARLES GOODWIN, Jun., Philadelphia, Pa. (Elected Dec. 22, 1930.) (Age 31.) Engr., New Eastern State Penitentiary, Graterford, Pa. Refers to J. B. Corridon, F. S. Friel, W. E. R. Irwin, J. W. May, J. J. Sweeney, A. J. Warlow.

DEWITT, DON ROBERT SMITHWICK, Jun., Riverside, Calif. (Elected Aug. 18, 1930.) (Age 32.) Senior Inspector, Metropolitan Water Dist. of Southern California. Refers to A. H. Adams, J. B. Bond, C. T. Leeds, R. G. McGlone, R. W. Remp, O. J. Schieber, A. L. Sonderegger.

Erickson, Archie Milton, Jun., New York City. (Elected Oct. 10, 1927.) (Age 31.) Faculty Member of School of Archt., New York Univ.; also Cons. Engr. Refers to H. G. Balcom, C. E. Beam, I. L. Collier, L. R. Hjorth, C. C. More, A. J. Wilcox.

Frost, Maurice Bayard, Jun., Haddon Heights, N.J. (Elected Jan. 18, 1926.) (Age 33.) Engr., New Jersey Water Co. Refers to N. S. Buckbee, C. Haydock, D. C. Morrow, R. J. Newson, E. S. Weed, F. H. Weed, P. S. Wilson.

Landwehr, Waldemar John, Jun., Madison, Wis. (Elected April 7, 1930.) (Age 32.) Engr., Madison Metropolitan Sewerage Dist. Refers to D. W. Mead, H. W. Mead, C. V. Seastone, L. C. Tschudy, C. N. Ward.

Lavergne Yordan, Luis, Jun., San Juan, Puerto Rico. (Elected March 27, 1933.) (Age 32.) Treas., Earl K. Burton, Inc., Engrs. Refers to J. Benitez Gautier, J. M. Bertram, S. Quinones, R. Ramirez, A. S. Romero.

Leonard, John Joseph, Jun., San Francisco, Calif. (Elected July 23, 1934.) (Age 32.) Chf. Engr., F. E. Booth Co., Inc., Pittsburg, Calif., Plant. Refers to A. V. Bowhay, M. J. Callaghan, E. C. Flynn, J. B. Leonard, R. H. Owens, G. L. Sullivan.

McDonnell, Porter Wilson, Jun., Toledo, Ohio. (Age 32.) Civ. Engr. and Surveyor. Refers to G. Champe, A. S. Forster, A Gardner, H. P. Jones, L. T. Owen, A. H. Smith, G. A. Taylor.

Mulholland, Jack, Jun., Brisbane, Australia. (Elected Nov. 23, 1931.) (Age 32.) Super. Engr., Irrigation & Water Supply Dept. Refers to G. M. Fair, A. Haertlein, W. H. R. Nimmo, R. A. Sutherland, C. Terzaghi, H. M. Turner.

Pappin, Gordon Francis, Jun., Great Falls, Mont. (Elected May 13, 1935.) (Age 27.) Contr.'s Engr. and Estimator, Pappin & Son, Gen. Contrs., Lovering-Longbotham Co. Refers to F. G. Birch, A. P. Learned, H. D. Lovering, J. B. Morrison, R. H. Willcomb.

Sahney, Jagdish Chandra, Jun., Jhansi, India. (Elected July 31, 1933.) (Age 28.) Dist. Engr., Dist. Board, Jhansi. Refers to J. R. Colabawala, J. Husband, A. N. Khosla, K. Singh. (Applies in accordance with Sec. 1, Art. I, of the By-Laws.)

Snyder, Charles Wilmer, Jun., Baltimore, Md. (Elected June 10, 1929.) (Age 31.) Chf. Engr., Acme Steel Eng. Co. Refers to H. L. Crandall, P. G. Crout, H. F. Doeleman, O. H. Schroedl, J. T. Thompson, C. A. Weiller, G. A. Wieman.

Strong, Charles Nicholas, Jun., Chicago, Ill. (Elected July 16, 1928.) (Age 32.) Engr., United Elec. Coal Cos. Refers to F. A. Barnes, R. H. Lee, J. E. Perry, H. C. Rapp, T. D. Sawyer, F. S. Senior.

Trigeiro, William Francis, Jun., Watsonville, Calif. (Elected Nov. 10, 1930.) (Age 32.) Dist. Designing Engr., U. S. Dept. of Agriculture. Refers to R. A. Beebee, C. Moser, H. E. Reddick, L. B. Reynolds, C. L. Young.

Valega, Raul Felix, Jun., Lima, Peru. (Elected Oct. 10, 1927.) (Age 32.) First Asst. Engr., Frederick Snare Corporation. Refers to A. M. Alvarez y de Urrutia, A. Deermont, M. Font, E. Gongora Pareja, A. F. Lipari, G. P. Seeley, Jr.

Whittaker, Howard James, Jun., Newark, N.J. (Elected Dec. 16, 1929.) (Age 32.) Office and Designing Engr., Essex County (N.J.) Park Comm. Refers to R. A. Boehringer, C. F. Chapman, S. C. Hamilton, Jr., J. L. Lenox, F. P. McKibben, J. H. Philips, W. C. Taylor.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 87 of the 1936 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

Construction

Construction Engineer; Jun. Am. Soc. C.E.; 2 years experience as assistant and secretary to general contractor. Has charge of all office and bookkeeping work. Keeps cost records of labor and material, estimates and draws plans, prepares specifications, supervises construction jobs. Graduate of Massachusetts Institute of Technology, 1934, building engineering and construction. Employed now; available. D-3092.

Construction, Office and Valuation Engineer; Assoc. M. Am. Soc. C.E.; 41; B.S. C.E.; 15 years experience railroad and bridge construction and valuation, railroad location, line and grade revision, and reporting same as required by Interstate Commerce Commission; 11 years in responsible charge; 8 months examining plans and specifications for PWA. D-4034.

Design

Civil Engineer; Assoc. M. Am. Soc. C.E.; licensed professional engineer, New York State; 35; married; A.B. (Fordham), B.S. C.E. (Manhattan College); 9 years experience in engineering, including detailing structural steel and iron, designing, drafting, estimating, surveying, and supervising various types of construction. Desires clerical or engineering position one or more evenings a week. C-6554.

Executive

Graduate Sanitary Engineer; Assoc. M. Am. Soc. C.E.; 29; Pennsylvania State College; 7 years experience in design, surveys, and inspection of highways and bridges. Desires position in either civil or sanitary engineering, field or office. D-4919.

Structural Engineer; Assoc. M. Am. Soc. C.E.; graduate civil engineer, New York license. Long experience in design and construction; 12 years in charge of work. Resident engineer and construction superintendent, details, design, estimating, specifications, and inspection; power plants, mill buildings, manufacturing plants, docks, terminals, chimneys, penstocks, steel, concrete, and foundations. Available immediately for responsible position. B-5239.

Consulting Engineer, Chicago, Ill.; M. Am. Soc. C.E.; 50; married; graduate civil engineer; structural engineer registered in Illinois; 28 years experience large industrial plants, commercial building projects, appraisals, reports, etc.; established name in Chicago; available for association, or employment, with responsible engineering or construction organization. Will consider other desirable locations. B-7647.

Chemical and Sanitary Engineer; Assoc. M. Am. Soc. C.E.; 30; married; graduate of Massachusetts Institute of Technology; 9 years local and foreign experience. Design, construction, and operation of public and industrial water treating plants; iron removal; disposal of sewage and industrial waste. Good record; excellent references. Now employed; available June 1st. Satisfaction guaranteed. D-4895.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 20 years experience on drainage, highway, and railroad work and as contractor's engineer; estimating, bidding jobs, superintendent of construction on dredging, earth moving, bridges, drainage of structures, foundations, docks, and sewers. Familiar with floating equipment. Available on about two weeks notice. Southern states preferred. D-3490.

Civil Engineer; Jun. Am. Soc. C.E.; graduate of University of Iowa; German-American; married with family; age 32; average weight and height; 1 year teaching fellowship in civil engineering, University of Minnesota; 7 years experience in highway and civil engineering. Wishes connection with good company or its equivalent. Location immaterial. References. C-3977.

Junior

Civil Engineer; Jun. Am. Soc. C.E.; 25; single; B.S. in C.E., Rhode Island State College, 1934; some experience as a rod and instrumentman; familiar with U. S. Coast and Geodetic Survey plane coordinates; civil service list as draftsman. Desires opportunity in any branch of civil engineering. Location and salary secondary; available immediately. D-3214.

Engineer; Jun. Am. Soc. C.E.; 28; married; B.S. C.E., 1936, Massachusetts Institute of Technology; M.S., railroad operation, same institution; 5 years intermittent work in all departments of first-class railroad; also, 3 years work in metropolitan rapid transit in semi-official and official position in operating department. Location immaterial. Salary open. Available on two weeks notice. D-1987.

Civil and Sanitary Engineer; B.S. in civil engineering, 1935; M.S. in sanitary engineering, 1936, Virginia Polytechnic Institute; age 22; single. June 1935 to June 1936 research fellow in sanitary engineering, V.P.I. Desires employment in some phase of civil or sanitary engineering. D-4894.

Sanitary Engineer; Jun. Am. Soc. C.E.; 25; single; S.B. and S.M. in sanitary engineering, Massachusetts Institute of Technology; 1 year experience in hydraulic research. Anxious for experience in design or construction. Sanitary engineering preferred. Location immaterial. Two weeks notice. D-4721.

Civil Engineer; 28; graduate of Purdue University, 1931; desires position with engineering or construction organization. Experience: drafting, surveying, concreting, construction of gravel roads through swamp territory; swamp drainage; use of dynamite; technical foreman for CCC, $2^1/_2$ years. Will go anywhere. Salary open; available any time. D-1556.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 28; single; B.S. C.E., Union College, 1929; 6 years engineering experience, including 4 months highway construction, $2^1/_2$ years office and field work (large building construction firm, special course structural welding design), 3 years varied engineering experience in general construction. Desires position in any branch of civil engineering. Available. D-180.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 22; single; free to travel; B.S.E. and C.E., 1935, College of the City of New York; 6 months as assistant supervisor on concrete building construction; 7 months as rodman, chainman, instrumentman, and draftsman on topographic survey; 6 months as assistant field instructor in surveying; good structural steel draftsman and designer. Desires opportunity in civil engineering, especially surveying and building construction. D-4860.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 28; married; B.Sc. C.E., University of Illinois, 1930, $2^1/_2$ years as junior highway engineer, Illinois Division of Highways, drafting, proportioning engineer, inspecting, surveying; $2^1/_2$ years as reserve officer on active duty with CCC, administrative and executive experience. Desires civil engineering position. Location immaterial. Available 15 days. D-4926.

SALES

SALES AND DESIGNING ENGINEER; Assoc. M. Am. Soc. C.E.; member, American Institute of Chemical Engineers; registered; specializing in petroleum; gasoline plants; field equipment. Wide acquaintance mid-continent and Rocky Mountain areas; intimate knowledge of field conditions and new developments. Seeks position with manufacturer, established engineers, banking or insurance house, valuations and checking royalties. D-4893.

TEACHING

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 29; B.S., U. S. Military Academy; C.E., M.C.E., Sigma Xi, Cornell University; experience in flood control studies, hydrology, hydraulic research, river improvement, economics of river improvements, organization for and direction of such studies. Desires responsible teaching position. Interested in research. Location immaterial. D-4234.

CIVIL ENGINEER; Assoc. M. Soc. C.E.; Society for Promotion of Engineering Education; age 38; B.A., B.S., M.S. degrees; 10 years experience teaching civil engineering subjects, surveying, concrete design, structural analysis; 3 years highway work. Now assistant professor in mid-western college. Desires to improve position. D-4935.

STRUCTURAL ENGINEER; Jun. Am. Soc. C.E.; 29; married; B.S. and S.M. in C.E.; specialist in statically indeterminate structures, theory and design; 5 years research, teaching, and practice in United States; 3 years in Europe (1 year advanced study; 2 years teaching). Available August 1. D-2896.

INSTRUCTOR IN CIVIL AND SANITARY ENGINEERING; Jun. Am. Soc. C.E.; 28; C.E., M.S. in sanitary engineering; 4 years experience as university instructor—2 as research assistant in sanitary engineering, and 2 in practical engineering work. Desires position on university faculty with opportunity for advancement. Available June 15. C-4700.

COLLEGE PROFESSOR; M. Am. Soc. C.E.; 45; master's degree from Cornell University; 12 years teaching; 12 years responsible experience, largely in sanitary engineering; at present associate professor of civil engineering in charge of sanitary and hydraulic engineering and research. Responsible position desired as head of department or full professorship. B-7678.

UNIVERSITY INSTRUCTOR; Assoc. M. Am. Soc. C.E.; desires a position as assistant professor with an opportunity to teach sanitary engineering; 13 years teaching experience; master's degree in sanitary engineering. B-7785.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 77 of the Year Book for 1936. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

AN ENGINEER'S RECOLLECTIONS. By John F. Stevens. New York, McGraw-Hill Book Company, 1936. 70 pp., illus., maps, $9^1/_4 \times 6^1/_4$ in., paper, $1.

In this book John F. Stevens gives the story of many incidents in his career. These recollections begin with his life as a young man on railroad construction in the wilderness of western Canada and continue through the time he directed the invasion of Oregon by the Northern Pacific and the Great Northern. Chapters on the construction of the Panama Canal are also included in this story of a notable career.

ARCHITECTURAL DRAWING AND DETAILING. By J. R. Dalzell and J. McKinney. Chicago, American Technical Society, 1936. 212 pp., diagrs., 9 × 6 in., cloth, $2.

The elements of architectural drawing, detailing, rendering in pen and ink, and landscaping are presented in this volume, which is prepared to meet the needs of home students. Principles are discussed, and directions for procedure are given in thorough detail. Practice problems are included.

ARCHITECTURAL GRAPHIC STANDARDS FOR ARCHITECTS, ENGINEERS, DECORATORS, BUILDERS, AND DRAFTSMEN. By C. G. Ramsey and H. R. Sleeper. 2 ed. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd., 1936. 284 pp., diagrs., charts, tables, 12 × 9 in., cloth, $6.

This collection of data and standards is intended to lighten the work of architectural draftsmen and engineers by providing the material frequently used in convenient form. The graphic method of presentation is used throughout. The new edition is much enlarged. Over 3,600 items are represented in the 260 plates.

BETRIEBSWISSENSCHAFT DES INGENIEURBAUES. (Sammlung Göschen 1097.) By M. Mayer. Berlin and Leipzig, Walter de Gruyter, 1936. 158 pp., diagrs., 6 × 4 in., cloth, 1.62 rm.

This little volume applies scientific management to engineering construction. Methods of construction and of handling and storing materials, the materials and equipment of the builder, and the handling of labor are discussed from the viewpoints of organization and efficiency.

LEGAL AND ETHICAL PHASES OF ENGINEERING. By C. F. Harding and D. T. Canfield. New York and London, McGraw-Hill Book Co., 1936. 432 pp., diagrs., tables, 9 × 6 in., cloth, $4.

The aim of this book is to equip the young engineer with some of the more important legal and ethical principles which must govern his business relations with other engineers and the public. Among the subjects discussed are the law of contracts, specifications and estimates, the expert witness, patents, the law of agency and of sales, public relations, and professional ethics.

(THE) LINCOLN HIGHWAY, the Story of a Crusade That Made Transportation History. New York, Dodd, Mead & Co., 1935. 315 pp., illus., 8 × 6 in., cloth, $2.50.

The story of the movement to build an improved highway from the Atlantic to the Pacific is here told in detail, from the inception of the idea to the completion of the road. This is the official history of the Lincoln Highway Association. Appendixes contain lists of the founders, major contributors, and officers, and brie[f] biographies of the officers and directors.

MITTEILUNGEN AUS DEN FORSCHUNGSANSTALTEN GHH-KONZERN, Band 4, Heft 2, October 1935. pp. 33–58, illus., diagrs., charts, tables, 12 × 8 in., paper, 2.90 rm.

The first paper in this pamphlet, by J. Kunzberg, gives a simple formula for determining the weight of a plate girder from the width of span, the method of support, and the load. The second paper, by K. Schulze-Allen, presents the advantages of the Bostock-Renk globoid helical gearing. The third paper presents the results of an experimental study of the swelling and shrinking of concrete, by G. Mussgnug. Finally, A. Schlimbach describes the construction and efficiency of the M A N propeller pump.

MUNICIPAL YEAR BOOK, 1936. Chicago, International City Managers' Association. 475 pp., tables, 10 × 7 in., cloth, $4.

This annual affords a review of the activities of American cities and the statistical data concerning them. The first section discusses specific developments in many fields of municipal administration. The second section discusses local governmental units in the United States and includes tabulated information on the size, form of government, voters, etc., of all cities of over 10,000 population. Succeeding sections treat of municipal personnel and finance. Finally, a section is devoted to the services and information made available by federal and national agencies. The handbook brings together a great amount of material frequently wanted by students and officials.

NEUE WEGE DER GRUNDSTÜCKSBEWERTUNG. By E. Runge. Berlin, VDI-Verlag, 1935. 48 pp., tables, 8 × 6 in., paper, 2.80 rm.

This book presents a new plan for valuing buildings and land in Germany, based upon economic and political factors of the present day.

OUR ENEMY, THE TERMITE. By T. E. Snyder. Ithaca, N.Y., Comstock Publishing Co., 1935. 196 pp., illus., diagrs., maps, tables, 9 × 6 in., cloth, $3.

The author of this useful manual has studied the termite for twenty-six years, and his book is largely based on his experiences. The termite is treated from both the economic and entomological points of view, six chapters being devoted to biology, the remaining four to the relationship of the insect to man. Damage done by termites and methods of control are described.

TRAFFIC CONTROL AT SIGNALIZED STREET INTERSECTIONS. By Bernard T. Schad. Ann Arbor, Mich., University of Michigan, 1935. 160 pp., diagrs., tables, charts, 9 × 6 in., paper.

This book traces the evolution of traffic regulation in various countries and describes the methods of control in use in large cities, including New York, Chicago, Philadelphia, and Detroit. Mr. Schad has devoted comprehensive chapters to traffic signal colors, the different systems of signal control, traffic-actuated control, and kindred subjects. This material was originally submitted to fulfill the requirements for the degree of doctor of science at the University of Michigan.

TRAVAUX MARITIMES, Vol. 3. (Bibliothèque de l'Ingenieur de Travaux Publics.) By L. Prudon. Paris, Dunod, 1936. 432 pp., illus., diagrs., charts, tables, 7 × 5 in., cloth, 87 frs.; paper, 78 frs.

The third volume of this treatise treats of the construction and maintenance of the works used in circulation and in loading and repairing ships. Landing quays, locks and passages, tide basins, lock gates, dry docks and caissons are described, with numerous examples of important works.

VDI-JAHRBUCH 1936, Die Chronik der Technik. Berlin, VDI-Verlag, 1936. 192 pp., tables, 8 × 6 in., paper, 3.50 rm.

The Jahrbuch provides a convenient review of the principal developments in engineering during the year 1935, in the form of 83 summaries by specialists. Full references to the original articles accompany each essay. All branches of technology are covered, and about 6,000 articles are cited. The engineer who reads German will find the book a useful reference work.